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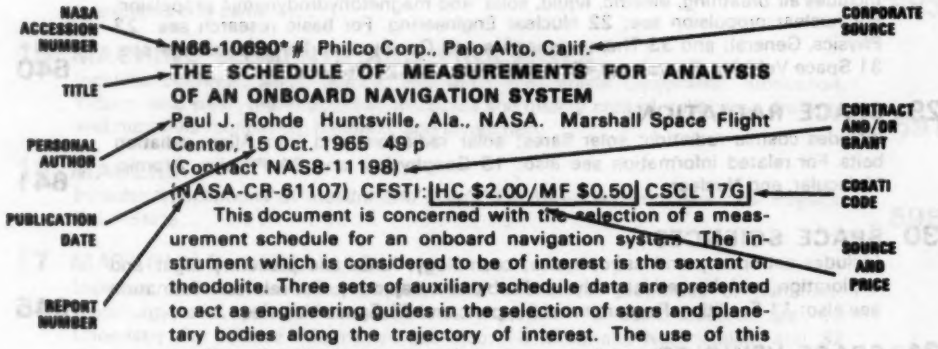
NASA ACCESSION NUMBER
CORPORATE SOURCE
N66-10690* # Philco Corp., Palo Alto, Calif.
TITLE
THE SCHEDULE OF MEASUREMENTS FOR ANALYSIS OF AN ONBOARD NAVIGATION SYSTEM
CONTRACT AND/OR GRANT
PERSONAL AUTHOR
Paul J. Rohde Huntsville, Ala., NASA. Marshall Space Flight Center, 15 Oct. 1965 49 p
(Contract NAS8-11198)
(NASA-CR-61107) CFSTI: HC $2.00/MF $0.50 CSCL 17G
COSATI CODE
PUBLICATION DATE
This document is concerned with the selection of a measurement schedule for an onboard navigation system. The instrument which is considered to be of interest is the sextant or theodolite. Three sets of auxiliary schedule data are presented to act as engineering guides in the selection of stars and planetary bodies along the trajectory of interest. The use of this auxiliary data is demonstrated along a round trip Mars trajectory and a lunar trajectory. The value of using the auxiliary data as a guide is verified by obtaining tracking schedule evaluation data from a digital computer simulation of an onboard tracking system.
Author
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## TYPICAL CITATION AND ABSTRACT FROM *STAR*

VOLUME 4 NUMBER 4

# Scientific and Technical Aerospace Reports



A Semimonthly Publication
of the National Aeronautics and Space Administration

February 23, 1966

## 01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**N66-13409#** Aeronautical Research Council (Gt. Brit.)
**WIND TUNNEL MEASUREMENTS OF THE FAR-FIELD PRESSURES DUE TO SOME LIFTING, SLENDER DELTA WINGS**
T. A. Cook London, HMSO, 1965 32 p refs Supersedes RAE-TN-AERO-2976, ARC-26436
(ARC-CP-802; RAE-TN-AERO-2976; ARC-26436)

Measuremnts have been made of the pressure field in the plane of symmetry of each of three slender delta wings of unit aspect ratio, at a distance of 12 model lengths from each model and at a Mach number of 1.80. One model was uncambered while the others were cambered to have attached flow at their leading edges at $C_L = 0.1$: the cambered models had different lengthwise lift distributions. Estimates of the front shock wave strengths of the models made using Whitham's theory were found to be in good agreement with the measured values, though estimates of lift effects seemed a little low. An estimate of the complete pressure signature of a model at zero lift agreed well with measurements. Author

**N66-13444#** Michigan Univ., Ann Arbor. Infrared Physics Lab.
**BALLISTIC MISSILE RADIATION ANALYSIC CENTER. VOLUME I: GENERAL REVIEW Sixth Annual Report, 1 Jul. 1964-30 Jun. 1965**
D. J. Lovell Oct. 1965 28 p refs
(Contract ARPA SD-91)
(Rept.-4613-100-F (1); AD-472848)

In Volume I, BAMIRAC's responsibilities are reviewed. Specifically summarized are studies of hypersonic wakes and the aerodynamic structure of rocket exhaust jets, experimental investigations of infrared radiative transfer in hot gases, and basic methods in radiometric calibration. Theoretical considerations of phenomena anticipated to be associated with midcourse phase of missile flight are reported. The information handling activity is summarized. The above-named studies are related to the BAMIRAC task of developing interpretive models of optical radiation. Volume II presents spectral and temporal models of the radiation emitted by vehicles entering the earth's atmosphere, with the relevant physical processes noted. Author (TAB)

**N66-13470#** ARO, Inc., Arnold Air Force Station, Tenn.
**PRESSURE DISTRIBUTION AND FLOW VISUALIZATION TESTS OF A 1.5 ELLIPTIC CONE AT MACH 10**
R. L. Palko and A. D. Ray Arnold Eng. Develop. Center, Aug. 1965 61 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-163; AD-414567)

Results are presented for tests conducted on 1.5 elliptic cone to determine the pressure distribution, flow streamlines, and shock wave shape at high angles of attack. The tests were performed at a Mach number of 10 and a free stream unit Reynolds Number of $1.6 \times 10^6$ per foot. The angle of attack range was from 0 to 60 deg. The model was oriented both with the major and the minor axis of the ellipse located in the pitch plane. Author

**N66-13482*#** National Aeronautics and Space Administration, Washington, D. C.
**THREE-DIMENSIONAL SUPERSONIC EQUILIBRIUM FLOW OF A GAS AROUND BODIES AT THE ANGLE OF ATTACK [TREKHMERNOYE SVERHKZVUKOVOYE RAVNOVESNOYE TECHENIYE GAZA OKOLO TEL POD UGLOM ATAKI]**
O. N. Katskova and P. I. Chushkin Dec. 1965 27 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 5, no. 3, May-Jun. 1965 p 503-518
(NASA-TT-F-9790) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A method of trigonometric approximation is developed for the case of an arbitrary number of meridional planes. A special variation of the numerical-characteristic method is worked out for the determination of flow parameters. In this technique, the numerical solution is developed by means of bands perpendicular to the axis of the solid. The method is said to ensure second-order accuracy and to make possible the use of a continuous trigonometric approximation, thus minimizing the number of layers and meridional planes to be dealt with. Author

**N66-13500#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**RESULTS OF COMPUTING THE BOUNDARY LAYER ON BLUNT CONES IN A SUPERSONIC FLOW**
A. L. Ankudinov [1965] 8 p refs Transl. into ENGLISH from Vychisl. Mat. i Mat. Fiz. (USSR), v. 5, no. 5, 1965 p 960-965

The results of a computation of the boundary layer on spherically blunt cones in a supersonic air flow for a constant wall temperature and for a heat insulated wall are presented. The results are presented in the form of graphs. R.N.A.

**N66-13514#** Boeing Scientific Research Labs., Seattle, Wash.
**EXPERIMENTAL AND THEORETICAL PROBLEMS IN JET IMPINGEMENT**
E. W. Graham Jan. 1964 13 p refs
(TM-28)

Wind and obstacle effects on the flow from a rotor near the ground are investigated to study recirculation. The width, height, radial distance and inclination of the obstacle to the radial direction are analyzed. Propeller height, disc loading, and the pinching in of the vortex filaments at one side of the propeller disc are considered. Axial variations in the small perturbation solutions of the Navier–Stokes equations, and series solutions of the Navier–Stokes equations without linearization are studied. M.R.W.

**N66-13555*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**THE USE OF CONVENTIONAL WIND TUNNELS TO SIMULATE PLANETARY ATMOSPHERIC AERODYNAMICS**
Howard Koester and Norman Fox 15 Nov. 1965 14 p refs
(Contract NAS7-100)
(NASA-CR-68792; JPL-TR-32-762) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The aerodynamic effects of planetary atmospheric simulation have been experimentally investigated in wind tunnels. Admixtures of carbon dioxide into the conventional dried air working fluid were used to simulate variations of the atmospheric properties. The performance of the wind tunnels, the techniques used, and samples of the data obtained are presented. The results obtained indicate that, within a given range, this approach will yield excellent data for planetary atmosphere entry vehicle design. Author

**N66-13580#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**MASS TRANSFER IN THE LOW REYNOLDS NUMBER VISCOUS LAYER AROUND THE FORWARD REGION OF A HYPERSONIC VEHICLE**
L. Goldberg and S. M. Scala Jul. 1965 44 p refs
(R65SD27; AD-623553) CFSTI: HC $2.00/MF $0.50

The paper describes a theoretical investigation of the effect of mass transfer into the hypersonic low Reynolds number viscous layer upon the heat transfer rate and skin friction. New results have been obtained and correlated as a function of the Reynolds number. The range of applicability of the present fluid dynamic model is also discussed and comparisons are drawn with earlier work, both theoretical and experimental. Author (TAB)

**N66-13589#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**HANDBOOK OF SUPERSONIC AERODYNAMICS. SECTION 17: DUCTS, NOZZLES AND DIFFUSERS**
Lester L. Cronvich and Ione D. V. Faro Jan. 1964 438 p refs
(Contract NOw-62-0604-c)
(NAVWEPS-1488, Vol. 6; AD-613055) GPO: $3.25

This Handbook section presents the basic techniques and related information needed for the control of duct flow in high-speed propulsion devices and in supersonic and hypersonic wind tunnels. The general mechanical and thermodynamic theory of steady flow in a duct is simplified as much as possible and is concisely reviewed. The effects of many flow parameters are analyzed by considering simple one-dimensional flows in which all but one of the independent variables are held constant. Although such assumptions are somewhat restrictive, it has been shown that their use in many practical problems provides reasonably accurate results. Non-steady, one-dimensional flows are discussed, and methods of solution for a great number of practical problems are outlined. Two- and three-dimensional flows are touched upon briefly. Generalized techniques are presented for the inclusion of viscous and heat-transfer effects by means of which boundary-layer correction may be made to profiles designed for potential flow. The general solutions of duct flow are subsequently applied to specific problems concerning the air intakes of jet engines, various propulsion nozzles, as well as nozzles and diffusers for typical supersonic and hypersonic wind tunnels. TAB

**N66-13601#** California Univ., Berkeley. Inst. of Engineering Research.
**WALL TEMPERATURE EFFECTS ON THE ZERO-LIFT VISCOUS DRAG OF BLUNTED CONES IN RAREFIED SUPERSONIC FLOW**
Donald R. Crawford Sep. 1965 71 p refs
(Contract Nonr-222(45); Grant NSF GP-2520)
(AS-65-15; AD-473420)

Drag coefficient data for hemispherically blunted 15 degree semi-angle cones were obtained experimentally for a Mach number of 5.8. The Reynolds number based on the model base diameter ranged from 550 to 3700 and the ratio of the wall temperature to the stagnation temperature varied from 0.07 to 0.94. The drag was found to increase linearly with increasing wall temperature with the bluntest cones being most sensitive to the change in wall temperature. The percentage drag increase over the experimental temperature range was at least 11%, and as much as 19% for all models tested. At a constant wall temperature ratio the drag coefficient was linearly dependent on the hypersonic viscous parameter with the value for the sharp cone being adequately predicted by second order boundary layer theory. With the wall temperature ratio and the hypersonic viscous parameter fixed the viscous drag coefficient for blunted cones was found to be relatively independent of the bluntness ratio. Author (TAB)

**N66-13698#** David Taylor Model Basin, Washington, D. C.
**STEADY TWO-DIMENSIONAL PRESSURE DISTRIBUTIONS ON ARBITRARY PROFILES**
Terry Brockett (M.S. Thesis—Cornell Univ., May 1965) Oct. 1965 81 p refs
(DTMB-1821; AD-622769) CFSTI: HC $3.00/MF $0.75

A method of determining two-dimensional pressure distributions on arbitrary foils is explained. The development is based on an approximate potential theory suggested by Moriya which is empirically modified in a manner suggested by Pinkerton to give an arbitrary lift for a set incidence and at the same time satisfy the Kutta condition. Interpolation functions for the ordinates are used to reduce the calculations to a straightforward numerical procedure which is easily programmed for machine calculations. (FORTRAN statements for such a computer program are included.) The results are those of Riegels. Comparisons are made with other theoretical methods for potential flow and with experimental results. Good agreement with both calculated and measured pressure distributions is found when the lift coefficients are matched. The assumption that cavitation occurs when the local pressure falls to the vapor pressure is not upheld for the cases considered. Author (TAB)

**N66-13767#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
**ANALYSIS AND CORRELATION OF HELICOPTER ROTOR BLADE RESPONSE IN A VARIABLE INFLOW ENVIRONMENT Final Report**

Raymond G. Carlson and Kurt D. Hilzinger Fort Eustis, Va., Army Aviation Mater. Labs., Sep. 1965 119 p refs
(Contract DA-44-177-AMC-87(T))
(USAAVLABS-TR-65-51; SER-50405; AD-622412) CFSTI: HC $4.00/MF $0.75

The program was conducted to determine the ability to predict Helicopter rotor response with a combined analysis based on the Sikorsky aeroelastic analysis and the Cornell Aeronautical Laboratory variable inflow analysis. The Sikorsky analysis is a fully coupled flatwise-edgewise torsional dynamic analysis modified to incorporate refinements in rotor trim and airload calculation and to adapt it for use with the variable inflow analysis. Analytical results were compared with available flight data for steady level flight of the H-34 at 41, 70, and 112 knots with a neutral center of gravity (C.G.), and 73 knots with aft C. G., as well as the HU-1A at 113 knots with neutral C. G. Fairly good correlation with test data was obtained. The analysis gave better correlation of blade air loads and bending moments than had been obtained from constant inflow analysis. In particular, more realistic values were obtained for the higher harmonic root-shear forces needed to define airframe response. While further improvement can be obtained by refinement of the variable inflow analysis, the combined analysis developed for the program provides an improved design tool for rotor blade evaluation. Author (TAB)

**N66-13967#** Chrysler Corp., Detroit, Mich. Missile Div.
**CCMD COMPUTER PROGRAM FOR THE COMPUTATION OF NON-LINEAR NORMAL FORCE AND PITCHING MOMENT COEFFICIENTS BY KELLY'S VISCOUS CROSSFLOW METHOD**
J. E. Foley 10 Jul. 1964 43 p refs
(ADB-TN-13-64)

This report describes the computer program for the estimation of non-linear contributions to the normal force and pitching moment coefficients for bodies of revolution. The program is written for the Philco 2000 computer and is based on Kelly's viscous crossflow method. Included in the program is a computation of an effective body shape, to be used in the linear aerodynamic analysis, which accounts for the presence of a boundary layer. The limitations and accuracy of the method are discussed. Program operating instructions, input/output, flow chart, Fortran list, etc., are given. Author

**N66-13977#** Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
**QUESTIONS AND COMMENTS ON THE MAXIMUM LIFT, JET MIXING AND JET IMPINGEMENT PROBLEMS**
E. W. Graham Jan. 1965 14 p refs
(TM-37)

Comments are presented on problems of maximum lift of the finite span wing, the mixing of a wall jet, and jet impingement. The trailing vorticity on the wing surface, lift calculations, the infinite $C_{Lmax}$ in slender wing theory, and extensions of the slender wing theory are discussed in the maximum lift problem. Discussions of mixing length and eddy viscosity modifications, applications of eddy viscosity methods, integral and similarity methods, and normal Reynolds stresses are included on the jet mixing problem. Jet impingement discussions include measurement of the force of an obstacle, jet boundaries, and vortex system stability. R.N.A.

**N66-14016#** RAND Corp., Santa Monica, Calif.
**INVISCID CONE FLOWS WITH SURFACE MASS TRANSFER**
Jerome Aroestry and Stephen H. Davis Sep. 1965 8 p ref
(P-3231; AD-622431) CFSTI: HC $1.00/MF $0.50

The paper discusses a simple, exact solution of the inviscid equations of motion which includes the effect of surface mass transfer. The slip surface location is determined solely from the solution of the injectant flow field. TAB

**N66-14043#** Aeronautical Research Council (Gt. Brit.)
**THE CALCULATION OF LATERAL STABILITY DERIVATIVES OF SLENDER WINGS AT INCIDENCE, INCLUDING FIN EFFECTIVENESS, AND CORRELATION WITH EXPERIMENT**
A. Jean Ross London, HMSO, 1965 35 p refs Supersedes RAE-AERO-2647; ARC-23089
(ARC-R&M-3402; RAE-AERO-2647; ARC-23089) HMSO: 15s

Comparisons are made between low-speed experimental results and estimates based on attached-flow theory for the lateral stability derivatives of slender wings at incidence, and it is found that the flow separation has little effect on the sideslip derivatives. The reduction in $l_v$ due to part-span anhedral is evaluated, and a semi-empirical formula is derived to account for important second-order terms. For the rotary derivatives, an attempt is made to estimate the effect of the leading-edge vortices, but no satisfactory conclusions have been reached. The fin contributions to the derivatives are evaluated on the basis of treating the wing surface as a total reflection plate. Good agreement with experiment is reached for the sideslip derivatives, and for the damping-in-yaw at moderate incidences. Sidewash is found to have a large effect on the rolling derivatives, and further information on the strength and position of the leading-edge vortices in non-symmetric flow is required before a complete calculation of the sidewash can be given. Author

**N66-14044#** Aeronautical Research Council (Gt. Brit.)
**CALCULATION OF UNSTEADY GENERALISED AIR-FORCES ON A THIN WING OSCILLATING HARMONICALLY IN SUBSONIC FLOW**
D. E. Davies London, HMSO, 1965 53 p refs Supersedes RAE-STRUCT-290; ARC-25323
(ARC-R&M-3409; RAE-STRUCT-290; ARC-25323) HMSO: £1 2s 6d

A method of obtaining numerical values of generalized air-forces on a thin wing oscillating harmonically in subsonic flow is described. It is assumed that the linearized equations of potential flow are valid. The essence of the method is the approximate solution, by collocation, of the integral equation relating the loading distribution and upwash on the wing and the use of the loading distribution so determined to calculate the generalized forces on the wing and control surfaces at general frequencies of oscillation. Author

**N66-14145#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**AERODYNAMIC RESISTANCE OF SMOOTH-PIPE STAGGERED BUNDLES IN A CROSS FLOW OF AIR AT HIGH RE NUMBERS**
Yu. K. Stasyulyavichyus and P. S. Samoshka 22 Sep. 1965 10 p refs Transl. into ENGLISH from Akad Nauk Lith. SSSR, Ser. B. (Vilnius), no. 4, 1963
(FTD-TT-64-1152/1+2+4; AD-622464) CFSTI: HC $1.00/MF $0.50

An experimental investigation was made of the resistance of five smooth-pipe staggered bundles a/b = 1.27–1.94 in a cross flow of air in the interval Re of from 10,000 to 2,000,000. The dependence of the resistance of the bundles on the number of longitudinal rows z2 was investigated. It was established

that the character of the resistance stabilizes at seven longitudinal rows and does not depend on further increase in the number of them. The results were evaluated in criterial form and the graphic dependences are given. Analysis of the material obtained showed that in the region Re = (1.8–1.6) × 100,000 there begins the transition into the self-modeling zone of developed turbulence. In close-staggered bundles (a/b < or = 1.7), the self-modeling zone occurs immediately, but in less close ones (a/b > 1.7) the automatic operation sets in after the transition zone. Author (TAB)

**N66-14153*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**STATIC AERODYNAMIC CHARACTERISTICS OF A ROCKET VEHICLE WITH THICK WEDGE FINS AND SWEPTBACK LEADING AND TRAILING EDGES**

Joseph A. Yuska Washington, NASA, Jan. 1966 16 p refs (NASA-TN-D-3182) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The longitudinal static stability characteristics of three one-fifth scale models of the second stage of a sounding rocket were calculated and compared with the measured values at Mach numbers of 1.79 to 3.47. All three models had fins of trapezoidal planform with sweptback leading and trailing edges, small aspect ratio, and thick wedge sections, but differed in fin area and overall model length. Calculations of center of pressure and normal-force coefficient slope at zero normal force were in good agreement with experimental data. Author

**N66-14181#** Library of Congress, Washington, D. C. Aerospace Information Div.

**MIXING OF CONCENTRIC HIGH VELOCITY AIR STREAMS Compilation of Abstracts**

16 Apr. 1964 42 p refs *Its* Rept.-2
(AID-U-64-24; AD-622933) CFSTI: HC $2.00/MF $0.50

The report is the second in a series dealing with published Soviet research on the subject of the mixing of concentric high-velocity air streams. It comprises abstracts of articles selected from Soviet open literature available at the Aerospace Information Division and the Library of Congress. TAB

**N66-14242#** Aeronautical Research Council (Gt. Brit.)

**MEASUREMENTS OF VORTEX-BREAKDOWN POSITION AT LOW SPEED ON A SERIES OF SHARP-EDGED SYMMETRICAL MODELS**

P. B. Earnshaw London, HMSO 1965 13 p refs Supersedes RAE-TR-64047, ARC-26601; See N65-20733
(ARC-CP-828; RAE-TR-64047; ARC-26601) HMSO: 3s

Measurements have been made at low speed of vortex-breakdown positions on a series of five, symmetrical wings, using a schlieren system to detect the position of breakdown. The results suggest that the modification of a delta planform to incorporate streamwise tips has little effect on breakdown position when this is forward of the modified tip. Examination of the large differences between these measurements and those from other sources suggests that the influence of cross-sectional shape even on nominally thin wings may be larger than expected and merits further investigation. Author

# 02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

**N66-13345** Library of Congress, Washington, D. C. Aerospace Technology Div.

**STATUS OF THE AIRSHIP IN THE USSR**

Vladimir Mutschall *In its* Foreign Sci. Bull., Vol. 1, No. 10 Oct. 1965 p 30–36 refs (See N66-13340 04-34)

Several articles have appeared recently in the Soviet press which seek to revive interest and stimulate action toward the achievement of a long-term program for the construction and operation of dirigibles. It is stated that the airship has been unwisely neglected and that the present total eclipse of the lighter-than-air craft should not be permanent. The most commonly cited advantages of the airship over other forms of transportation are that an airship can economically fly long distances non-stop, is a safe means of transportation if nonflammable helium is used, its lift is not achieved mechanically as in the case of the airplane and helicopter, it has improved navigational aids and aeronautical capabilities, and that it has engineering features which offer comfortable passenger accommodations. After a period of inactivity in airship research and development, the Soviet Union appears to have acquired new interest in building large, high-speed airships. Author

**N66-13428#** Aviation Safety Engineering and Research, Phoenix, Ariz.

**FULL-SCALE DYNAMIC CRASH TEST OF A DOUGLAS DC-7 AIRCRAFT**

W. H. Reed, S. H. Robertson, L. W. T. Weinberg, and C. H. Tyndall Apr. 1965 108 p
(Contract FA-WA-4569)
(FAA-ADS-37)

A full-scale dynamic crash test of a DC-7A aircraft was conducted to obtain crash environmental data to study fuel containment and to collect data on the behavior of various components and equipment aboard the aircraft. The aircraft was accelerated under its own power by remote control along a monorail nose landing gear guidance system for 4000 feet, reaching a velocity of 139 knots. The aircraft then impacted against specially designed barriers which removed the landing gear, permitting the aircraft to become airborne until impact with wing and fuselage barriers. The crash occurred with the planned sequence of events, but instead of coming to rest on the 20° impact slope as planned, the aircraft bounced over the hill on which this slope was formed and landed at the base of the backside of the hill. All photographic data throughout the aircraft and all cockpit environmental data were obtained and are discussed. Due to a voltage control regulator failure in the primary data recording system, quantitative data from the remainder of the instrumentation aboard the aircraft were lost. But for this failure, it is probable that all test objectives would have been met. R.N.A.

**N66-13721#** Army Transportation Research Command, Fort Eustis, Va.
**PRELIMINARY FLIGHT TEST DATA XH-51A RIGID ROTOR HIGH SPEED FLIGHT PROGRAM**
Dec. 1964 36 p
(IR-9; AD-621893) CFSTI: HC $2.00/MF $0.50

The report summarizes the flight test results of XH-51A compund helicopter testing. For this program, an XH-51A helicopter was modified to incorporate a wing and a J-60 auxiliary jet engine. The purpose of this phase was to obtain flight test data on performance, stability, maneuverability, critical stresses and vibration at speeds up to an objective of 200 knots. The data included present the results in these areas at speeds up to a level flight true airspeed of 210 knots.
Author (TAB)

**N66-14026#** Aviation Safety Engineering and Research, Phoenix, Ariz.
**SURVIVABILITY SEAT DESIGN DYNAMIC TEST PROGRAM**
L. W. T. Weinberg and James W. Turnbow Jul. 1965 121 p (Contract DA-44-177-AMC-191(T))
(USAAVLABS-TR-65-43; AD-621718) CFSTI: HC $4.00/MF $0.75

The report presents the results of a series of dynamic tests conducted with four different concepts of experimental crew seats. The experimental seats were designed and constructed by four helicopter manufacturers. The seats were designed to withstand static load factors equivalent to those recommended in TRECOM Technical Report 63-4, 'Crew Seat Design Criteria for Army Aircraft', dated February 1963. The design load factors recommended in the above referenced report were as follows: longitudinal—45G for 0.10 second; lateral—45G for 0.10 second; and vertical—25G for 0.10 second. Special kits for small arms ballistics protection were also designed and installed in the seats tested. These seats were designed exclusively using static load factors. No previous testing was conducted by any seat manufacturer prior to the conduct of these tests. The four seats were tested under four load conditions. Two of the conditions involved simultaneous half loads on the seats in two different seat positions, and two of the conditions involved full loads in two different seat positions. Only one of the four seats tested withstood the loads imposed for all four conditions. Three of the seats failed and were damaged beyond economical repair when each was subjected to the first full load test condition. The report also includes a detailed description of an acceleration device which was specially designed and fabricated for this series of tests.
Author (TAB)

**N66-14143#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**AIRFIELD MARKING PAINTS. I: EFFECT ON CRACKING OF SLURRY SEAL**
R. W. Drisko Oct. 1965 64 p refs
(R-400; Y-R007-08-03-303; AD-622555) CFSTI: HC $3.00/MF $0.75

A study is being conducted to determine the basic causes of early failure of airfield marking paints and the deterioration of underlying slurry seal and asphaltic pavement associated with these paints. In the present report, data and statistical analyses are presented on the initial cracking of slurry seal along the edges of stripes of 20 experimental paint formulations. Such cracking, which in some cases occurred as early as 2 weeks after application, was generally followed by edge lifting and then by loss of adhesion of slurry seal to the underlying asphaltic pavement. Stripes of paint containing chlorinated rubber cracked extremely rapidly, especially such stripes with a double thickness. Alkyd painted stripes generally had less cracking than oleoresinous painted stripes. Poorer performance of alkyd paints was associated with a solvent of high boiling range, and poorer performance of oleoresinous paints with solvents of low aromaticity. The addition of a slight amount of carbon black to the test paints raised the temperatures of stripes to only a very slight extent. This addition improved the performance of some test paints but lowered it for others. Stripes with greater flexibility generally had less edge cracking. There were numerous interactions between the above paint variables. Further causes of marking paint failure and the related damage to pavements and slurry seals are being investigated and will be reported later.
Author (TAB)

**N66-14198** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
**EFFECTS OF WEIGHT, INERTIA, AND VELOCITY ON CONTROL POWER REQUIREMENTS FOR VTOL AIRCRAFT**
Byron Harl Romine (M.S. Thesis) Aug. 1965 70 p refs
(GE/EE/65-20; AD-623100)

The pilot-vehicle systems analysis is applied to the problem of determining the effects of gross weight, inertia, and velocity on the stabilization control power requirements for the single-loop roll control system of a DOAK VZ-4 VTOL aircraft. The aircraft is subjected to random roll inputs in the form of atmospheric disturbances. Only the control power required to stabilize the aircraft roll angle by the pilot's use of ailerons alone is considered. The open-loop gain of the system is determined by maximizing the closed-loop damping ratio. There are no significant differences in the stabilization control power requirements at the gross weight conditions analyzed. Increased moments of inertia do not drive the system unstable, but the control power requirements decrease by about sixty percent as the moments of inertia are increased from 2800 slug-sq ft to 3300 slug-sq ft.
Author (TAB)

# 03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

**N66-13381*#** Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
**SPACE ELECTRIC POWER SYSTEMS STUDY, VOLUME 4 Final Report, Nov. 1961–Dec. 1962**
Edwin R. Procasky [1963] 154 p
(Contract NAS5-1234)
(NASA-CR-50861) CFSTI: HC $5.00/MF $1.00 CSCL 10B

The parametric data and preliminary system design for the space electric power system study are presented in this volume of the four volume report. The ratings of the parametric data are 250 and 500 kW at 5000 V. The specific weight of the system considered is higher than the specific weight of the one-megawatt system. The primary reason for the increase is that this system supplies auxiliary ac-loads, the generator operates at a lower frequency, and the general concept of weight savings as system ratings increase is borne out for this type of system in ratings below about 1 MW.
E.E.B.

**N66-13474*#** General Electric Co., Schenectady, N. Y. Research and Development Center.
**ELECTRODEPOSITED INORGANIC SEPARATORS Second Quarterly Report, 15 Jul.–15 Oct. 1965**
[1965] 20 p
(Contract NAS5-9168)
(NASA-CR-68627) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Progress is reported in a program to evaluate the use of thin electrodeposited films of calcium and magnesium hydroxide as separators in silver-cadmium cells. Process studies were made to determine the rates of film deposition for calcium and magnesium hydroxides on discharged silver electrodes. Parameters investigated were current density, electrolyte concentration, and deposition time, all at ambient temperature. Coating characteristics determined were weight gain, coating thickness, and resistance increase contributed by films in 31 percent by weight potassium hydroxide solutions. Coated silver electrodes were sterilized at 145°C for periods of forty hours, and were then fabricated into test cells to evaluate the electrochemical performance obtained, compared to unsterilized coated electrodes. C.T.C.

**N66-13517*#** Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena.
**ON THE DETAILED FLOW STRUCTURE AND THE CORRESPONDING DAMAGE TO TEST SPECIMENS IN A CAVITATING VENTURI Technical Report No. 16**
Marion John Robinson (Ph.D. Thesis) Aug. 1965 249 p refs /*ts* Rept.-03424-16-T
(Grant NsG-39-60)
(NASA-CR-68695) CFSTI: HC $6.00/MF $1.50 CSCL 13G

The cavitating flow behavior and resulting damage on test specimens were studied in a multiple-venturi closed-loop water system and in a single-venturi closed loop mercury test facility. Thin flat test specimens were inserted and fastened in the diffuser portion of the venturi. Pressures on the surfaces of the specimens were measured, and high speed photography was utilized to observe the flow around the test materials. Post-test examination and evaluation of the damage data established the following: (1) No single mechanical property correlated well with the mercury damage data; (2) a fairly good correlation was found for a combination of tensile strength and true breaking stress in mercury, and of tensile strength, true breaking stress and elastic modulus in water; (3) high strength materials showed the best correlation with predicted damage results in both fluids; (4) yield strength did not influence the damage correlation coefficient. G.G.

**N66-13586#** Eagle-Picher Co., Joplin, Mo. Couples Dept.
**ADVANCED DEVELOPMENT MODELS OF SEALED NICKEL–CADMIUM BATTERIES Final Report, 5 Apr.–16 Aug. 1965**
Jeff K. Wilson 16 Aug. 1965 17 p ref
(Contract DA-28-043-AMC-00070(E))
(NA-122; AD-623024) CFSTI: HC $1.00/MF $0.50

Development and production work has been directed toward the production of forty (40) each BB-467/U, BB-468/U, BB-469/U, BB-470/U, BB-471/U, and BB-472/U sealed nickel-cadmium batteries. The work has been directed toward the attainment of a new line of nickel-cadmium batteries in accordance with the Signal Corps Technical Requirements SCL-6868B. The batteries have ceramic seals, sintered nickel plaque plates, pellon and polypropylene separation, and contain 1.300 sp. gr. KOH electrolyte. The batteries must meet the specifications as stated in SCL-6868B. These specifications require batteries to discharge at 40F, meet stand test requirements at +80F and +160F, undergo temperature cycling, mechanical shock, acceleration, vibration, constant overcharge, and cycle life tests. Early models of these batteries have passed all these requirements except those for cycle life. Emphasis was placed on cell capacity, high rate discharge, storage at +160F, and constant overchange using BB-467/U batteries for the development units.
Author (TAB)

**N66-13623#** Rosemount Engineering Co., Minneapolis, Minn. Dept. of Aeronautical Research.
**EVALUATION OF FACTORS AFFECTING THE CALIBRATION ACCURACY OF AIRCRAFT STATIC PRESSURE SYSTEMS**
Richard V. De Leo, Floyd W. Hagen, Robert R. Kooiman, and Donald I. Thompson Wright-Patterson AFB, Ohio, Systems Eng. Group, Jul. 1965 132 p refs
(Contract AF 33(600)-42754)
(REC-66227; SEG-TR-65-35; AD-621678) CFSTI: HC $4.00/MF $1.00

Several factors affecting the calibration accuracy of flight vehicle static pressure systems were considered in some detail. The standard atmospheres used within the past 40 years are tabulated and compared. Altimeter calibration techniques and standards are discussed. The influence of pressure system leakage was evaluated both analytically and experimentally. The influence of skin irregularities in the vicinity of fuselage static pressure ports was calculated from linearized theory and the results presented in graphical form. Fuselage irregularities were measured on 18 military transport type aircraft.
Author (TAB)

**N66-13637*#** Eagle-Picher Co., Joplin, Mo. Couples Dept.
**INVESTIGATIONS LEADING TO THE DEVELOPMENT OF A PRIMARY ZINC-SILVER OXIDE BATTERY OF IMPROVED PERFORMANCE CHARACTERISTICS Final Report, 1 Jul. 1964–30 Jun. 1965**
B. R. Hawkins [1965] 81 p refs
(Contract NAS8-5493)
(NASA-CR-68563) CFSTI: HC $3.00/MF $0.75 CSCL 10C

Development work has been directed toward the design of an improved silver oxide-zinc battery of limited cycle lift. A specific goal has been thirty day activated stand at +90° F, during which time five partial discharges and one full discharge are conducted. Toward this end, phases of study have dealt with improved materials formulation, ratio of materials, electrolyte additives and effects of cell group "compactness" and volume of electrolyte. Whenever practical, the use of full or fractional designed experiments has been emphasized. Approximately three hundred test cells have been subjected to cycle regimes of one month duration. A large number of test cells were used in studies at improved material formulation. A prototype cell design including silver grid (both positive and negative), a decreased silver-zinc ratio, decreased material apparent densities, slightly less electrolyte and a more compact cell group has been evaluated. It is indicated that the cycle life goal has been attained, along with an increase in cell capacity of approximately twenty percent. This comprises an extension of activated life from seventy-two hours to approximately one month, with the addition of five cycles of twenty-five percent depth. This has been accomplished with no degradation in discharge voltage characteristics. Author

**N66-13641*#** Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
**DESIGN AND EVALUATION STUDY OF DEPLOYABLE SOLAR ARRAY FOR SPINNING SATELLITES Final Report**

Oct. 1964 98 p ref
(Contract NAS5-3989)
(NASA-CR-68479; SSD-4473R) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Solar cell array deployment systems are studied for application to spinning satellites. Systems which have the potential of more efficient packaging and deployment and offer increased performance in terms of specific power over a range of panel areas are studied in detail. The study includes the mechanical design, substrate properties, the evaluation and incorporation of chemical systems for space rigidization of flexible deployment systems, and cell assembly design and tests. The results of the study are presented on a chart listing the performance of seven deployment systems, four of which utilize flexible substrates and three utilize rigid substrates. The deployable systems based on flexible substrates and chemical rigidization offer the highest performance of 9.2 watts per pound and 383 watts per cubic foot of stowed volume. Author

**N66-13645*#** Yardney Electric Corp., New York.
**RESEARCH AND DEVELOPMENT OF THE SILVER OXIDE–CADMIUM ELECTROCHEMICAL SYSTEM Third Quarterly Progress Report, 10 May–9 Aug. 1965**
Allen Charkey [1965] 24 p
(Contract NAS5-9106)
(NASA-CR-68796) CFSTI: HC $1.00/MF $0.50 CSCL 10A

After "doping" with lead, silver electrodes showed improved performance characteristics at low temperatures. Also, no voltage dip was observed when these electrodes were discharged at moderately high rates at temperatures down to −10° C after a room temperature charge. Progress is reported in the following areas: (1) the effect of separator system on cell performance; (2) the effect of prolonged cycling on oxygen recombination; (3) the development of a ruggedized cadmium electrode; and (4) the effect of prolonged constant potential charging. R.R.D.

**N66-13648*#** Thermo Electron Engineering Corp., Waltham, Mass.
**APPLIED THERMIONIC RESEARCH First Quarterly Progress Report, 25 Jun.–25 Sep. 1965**
S. Kitrilakis, D. Lieb, F. Rufeh, and L. van Someren [1965] 67 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951262)
(NASA-CR-68799; TE23-66) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Progress is reported in the study of two types of cesium vapor thermionic converters. The first type uses cesium fluoride vapor in addition to metallic cesium. The use of cesium fluoride provides one additional degree of freedom in obtaining given electrode work functions. The second type of converter uses an inert gas in addition to cesium. It is expected that, under proper conditions, the presence of the inert gas will aid in the conservation of ions generated in the interelectrode volume and thus reduce the internal voltage drop. Argon was selected for the first experiments with inert gas additives because it was found that it can reduce the ion current appreciably, and it is transparent to electrons. R.R.D.

**N66-13649*#** Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.
**FABRICATION OF ONE SILICON–GERMANIUM THERMOELECTRICIC TEST UNIT Final Report**
R. C. Fortin 31 Aug. 1965 44 p
(Contract NAS7-100; JPL-951136)
(NASA-CR-68794) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Use of the thermoelectric test unit to aid in determining the applicability of silicon–germanium power modules to the requirements of space power systems is discussed. The unit was subjected to a life test through six thermal cycles spanning 330 hours of operation. The conditions selected permitted operation at maximum hot junction temperature, maximum $\Delta T$ capability and near maximum heater input. The performance observed reached the levels expected with average power output of 1.05 watts per couple. The test duration of 330 hours brought the unit through approximately 7.5% of the expected initial characteristic adjustment toward ultimate stability under the condtions used. R.R.D.

**N66-13715#** Melpar, Inc., Falls Church, Va.
**BIOCHEMICAL FUEL CELL Final Report, 1 Jul. 1962–30 Jun. 1965**
Gordon C. Blanchard and Charles R. Goucher [1965] 109 p refs
(Contract DA-36-039-SC-90878)
(Rept.-12; AD-622719) CFSTI: HC $4.00/MF $0.75

The study demonstrated the feasibility of using microorganisms to produce hydrogen in quantity and purity from natural products for use in simple fuel cell equipment. The study showed Clostridium welchii to be the best organism, and glucose or maltose the best substrate. Optimum conditions for maximum rate of hydrogen evolution both by resting and growing cells in 10-liter containers were evaluated. The maximum rate was 23 liters/hour. Cucumbers and banana proved to be the best natural products. A simple microbial generator using artificial and natural product substrates produced a 3.5-watt output for 24 hours. A periodic pH adjustment was required to maintain this output. Potential field applications for this process are discussed. Author (TAB)

**N66-13769#** Union Carbide Corp., Parma, Ohio. Research Lab.
**THIN FUEL CELL ELECTRODES First Quarterly Progress Report, 1 May–31 Jul. 1965**
M. B. Clark and K. V. Kordesch [1965] 41 p ref
(Contract DA-28-043-AMC-01344(E))
(Rept.-5; AD-623013) CFSTI: HC $2.00/MF $0.50

Gas diffusion and electrolyte concentration phenomena have been studied by varying thicknesses of the layers from which thin electrodes are constructed. Air cathodes showed a more pronounced response to thickness of the layers than did hydrogen anodes. The effect of a wetted porous layer in front of the electrode is to reduce cell output, but not in a linear fashion. The principal design features of a 6-volt, 100 watt air-hydrogen fuel cell are described. Tests on single cells of the same size are reported, and the test program for the batteries is outlined accordingly. Author (TAB)

**N66-13828*#** Borden Chemical Co., Philadelphia, Pa. Central Research Lab.
**IMPROVED SEPARATORS FOR SILVER OXIDE-ZINC AND SILVER OXIDE-CADMIUM CELLS FOR SPACECRAFT APPLICATION Second Quarterly Progress Report, 10 Feb.–9 May 1965**
Helmuth L. Pfluger and Howard H. Hoyt [1965] 19 p refs
(Contract NAS5-9107)
(NASA-CR-68847) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Improvement in the conductivity of methyl cellulose-polyacid films was brought about by increasing the proportion of the latter. These compositions while giving improved conductivity exhibited greater brittleness. Formulations incorporating polyvinyl alcohol or hydroxy ethyl cellulose were more flexible, but less oxidation resistant. Carboxymethyl methyl cellulose was prepared and made satisfactory films of good conductivity in 45% KOH. The presence of by-products

and co-products was observed to contribute to the improved conductivity. Work was continued on synthesizing polymers having requisite conductivity and flexibility without use of additives. Author

**N66-13829*#** Naval Ammunition Depot, Crane, Ind.
**LIFE CYCLE TESTS Monthly Progress Report**
31 Oct. 1965 157 p
(NASA Order W-11252-B)
(NASA-CR-68845) CFSTI: HC $5.00/MF $1.00 CSCL 10A

A tabulation of results of cycle tests conducted on nickel cadmium, silver cadmium, and silver zinc cells is presented. Test parameters are given and include such data as depth of discharge, test temperature, and position in pack. A brief failure analysis is listed for each cell tested. C.T.C.

**N66-13879#** Sandia Corp., Albuquerque, N. Mex.
**A LOW DC CURRENT GENERATOR**
David R. Kendall Jul. 1964 19 p
(Contract AT(29-1)-789)
(SC-TM-64-568)

This memorandum contains a description of the development of a low dc current generator used to calibrate various types of micromicro-ammeters. The output current range is $10^{-9}$ to $10^{-14}$ amperes with an estimated accuracy of $\pm 1/4$ percent. A linearly increasing voltage function coupled through a high quality air dielectric capacitor produces a constant output current. The generator utilizes a commercially available operational amplifier and power supply, thus keeping actual construction work to a minimum. Author

**N66-14162#** General Electric Co., Pleasanton, Calif. Special Purpose Nuclear Systems Operation.
**RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY**
29 Jun. 1965 7 p
(Contract NObs-90498)
(QR-4; AD-619379) CFSTI: HC $1.00/MF $0.50

Progress is reported on the development of a nuclear thermionic electrical generating system for the Department of the Navy. Work is being performed to develop the materials capabilities which are essential for this nuclear thermionic system. This work consists of three major tasks. They are: $UO_2$–refractory metal reaction kinetics, insulator materials development, ceramic-to-metal seal development. TAB

**N66-14183#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SPECTRA OF IRREGULARITIES OF A PROCESSED SURFACE, AND THEIR EFFECT ON THE LIFE OF TURBINE BLADES OF GAS-TURBINE ENGINES**
I. V. Dunin-Barkovskiy and S. Kh. Tupeyev 20 Oct. 1965 51 p refs Transl. into ENGLISH from Aviats. Tekhnol. Inst. Trudy. "Povysheniye Resursa Raboty Aviats. Detaley Tekhnol. Sredstvami" (Moscow), no. 60, 1964 p 72–107
(FTD-TT-65-1486/ 1+2+4; AD-623211) CFSTI: HC $3.00/MF $0.50

An examination is made of the effect of irregularities in the profile of processed surfaces on the life of blades, taking into account the effect of residual stresses, and the degree and depth of propagation of work hardening. The influence of certain technological factors on surface profile irregularities is explained. TAB

**N66-14218*#** Clevite Corp., Cleveland, Ohio. Electronic Research Div.
**DEVELOPMENT OF CADMIUM SULFIDE THIN FILM PHOTOVOLTAIC CELLS Final Report**
F. A. Shirland, J. R. Hietanen, F. Augustine, and W. K. Bower 15 Nov. 1965 65 p refs
(Contract NAS3-6461)
(NASA-CR-54806) CFSTI: HC $3.00/MF $0.75 CSCL 10A

The severe curling of the CdS film–plastic substrate combination was solved by laminating a second plastic layer on the other side of the CdS film. A highly conducting and strongly bonded coating was developed for the plastic substrate. With the Clevite barrier formation process this has resulted in large area frontwall plastic substrate cells with initial conversion efficiencies of 4 to 6% reproducibly. Coupled with decreases in CdS and plastic layer thicknesses these higher outputs have substantially increased the power to weight ratio of the CdS thin film solar cell. One 50 $cm^2$ area cell yielded 106 watts per pound. The performance and stability appear equivalent for both metal and plastic substrate constructions of the CdS thin film solar cell. Fabrication difficulties led to the postponement of further work on the backwall and backwall–frontwall combination cell constructions. The major factor in CdS film cell degradation has been pressure contact of the grid to the cell barrier. A promising method of attaching the grid with a conductive adhesive was developed, but so far cells with cemented grids have a tendency to degrade in output when exposed to prolonged temperature cycling. R.N.A.

**N66-14273*#** General Electric Co., Schenectady, N. Y. Research and Development Center.
**STUDY OF NICKEL–CADMIUM CELLS First Quarterly Report, 17 May–17 Aug. 1965**
[1965] 26 p
(Contract NAS5-9586)
(NASA-CR-68995) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Assembly and testing is reported for an oxygen monitoring system used in a behavior study of positive nickel hydroxide electrodes in nickel–cadmium cells. The apparatus continuously monitors oxygen evolution during controlled charge and discharge cycling. Basically, nitrogen carrier gas is fed to a manifold system through a precision pressure regulator so that the manifold pressure is held constant in the range of 20 to 30 psi gauge pressure. The flow rate of the carrier gas through the precision needle valves is essentially independent of minor pressure changes downstream. The gas is saturated with water vapor by bubbling through a solution of potassium hydroxide of the same composition as the test cell electrolyte. The flow rate of the saturated carrier gas is measured with a soap film flowmeter downstream of the bubbler. The carrier gas picks up oxygen being evolved by the nickel hydroxide electrode in the test cell and carries it to the oxygen sensor. A schematic is included of the cell and auxiliary equipment to illustrate the operating principles. C.T.C.

**N66-14277*#** Boeing Co., Seattle, Wash.
**DEVELOPMENT AND TESTING OF A LOW-TEMPERATURE HYDRAULIC SYSTEM. VOLUME I: ACTUATION APPLICATIONS TRADE STUDY Final Report**
Sep. 1965 103 p refs
(Contract NAS8-11722)
(NASA-CR-68368; D2-90795-1) CFSTI: HC $4.00/MF $0.75 CSCL 13G

The relative comparision of hydraulic, pneumatic, and electromechanical, actuation methods for selected space actuation tasks were determined by parametric evaluation studies. Provisions for power and thermal conditioning for each system were also considered. Each task was associated with one of four manned space vehicles: (1) an orbiting vehicle with subsequent reentry; (2) an orbiting vehicle without reentry; (3) a lunar landing vehicle; and (4) a lunar roving vehicle. Parameters used included weight, reliability, cost, availability, and performance, and a numerical representation showing the competitive positions of components in relation to these parameters was developed. Results show that the pneumatic thrust vector control, and the electromechanical centrifuge actuation systems are superior, leading to the recommendation of hydraulic systems on the basis of extensive operational experience at these power levels. The evaluations also show that space actuation systems need not operate in a temperature environment considered severe for hydraulics and, even in severe environments, environmental conditioning penalties are less for hydraulics than similar penalties for some other systems. M.G.J.

**N66-14278*#** Boeing Co., Seattle, Wash. Aerospace Group.
**DEVELOPMENT AND TESTING OF A LOW-TEMPERATURE HYDRAULIC SYSTEM. VOLUME II: HYDRAULIC SYSTEM ANALYSIS AND TEST PROGRAM Final Report**
Sep. 1965 148 p refs
(Contract NAS8-11722)
(NASA-CR-68983; D2-90795-2) CFSTI: HC $4.00/MF $1.00 CSCL 13G

The design, development, and fabrication of a hydraulic actuation system are discussed, and tests of the system in simulated space temperature and pressure environments are described. Fluids, seals, and materials for use in space environments were evaluated, and an analysis was made of thermal protection methods to isolate equipment from the effects of cryogenic space temperatures. A single-pass linear actuator test system and supporting equipment were designed to simulate the operational characteristics; these characteristics were determined during system operation at fluid temperatures as low as −165° and under hard vacuum storage at $10^{-8}$ torr for five months. Other testing investigated intermittent usage during a simulated lunar flight, operation at 275° F, and inactive thermal cycling between 275° and −240° F lunar surface temperatures. Methods and results are given, and it was concluded that hydraulic systems using advanced fluids are capable of performing many space actuation tasks. M.G.J.

**N66-14279*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**STUDY OF DRIFT-FIELD SOLAR CELLS DAMAGED BY LOW-ENERGY PROTONS Monthly Report, Oct. 15–Nov. 19, 1965**
J. De Pangher and D. L. Crowther [1965] 28 p refs
(Contract NAS5-9627)
(NASA-CR-68993) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Measurements were taken of (1) the I–V curves of all irradiated cells to check on annealing effects; (2) the spectral responses of three unirradiated control cells used to check stability of the sun simulator; and (3) the effect of cleaning the filters in the filter wheel spectrometer. The results are analyzed, and tabulated data are presented on the curve fitting. A drift field solar cell was used as a test case in comparing a measured spectral response with a spectral response from the n-layer solar cell model. The different layers in the construction of a drift field solar cell are depicted, and the distribution of impurity atom densities is formulated. The necessary parameters for calculating the solar cell model are listed, and an equation is expressed for fitting the experimental data. Results of the calculations for the drift-field solar cell and of the measurements obtained with the filter wheel spectrometer are graphed. A computer analysis of I–V data obtained for irradiated solar cells is also included. M.G.J.

**N66-14282*#** Harsaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
**CADMIUM SULFIDE PHOTOCONDUCTOR CELLS Final Report, Sep. 1964–Sep. 1965**
E. Hill [1965] 11 p
(Contract NAS5-5884)
(NASA-CR-68990) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Two general types of photoconductors have been made. One type uses a film of CdS deposited onto glass with light incident to the glass surface. A second uses a film of CdS deposited onto a metal foil with a high transparency metal grid overlaying the CdS. This is packaged in clear plastic with the light passing through the plastic and screen openings to the CdS. The second method is preferred for weight reduction and mechanical integrity. Samples of each type have been prepared, tested, and submitted. It is felt that the cell on metal foil is sufficiently flexible in design to meet requirements for large area, low density detectors. Author

**N66-14284*#** Naval Ammunition Depot, Crane, Ind.
**LIFE CYCLE TESTS Monthly Progress Report, Period Ending 30 Sep. 1965**
[1965] 152 p
(NASA Order W-11252-B)
(NASA-CR-68986) CFSTI: HC $5.00/MF $1.00 CSCL 10A

In the continuing life cycle program, details are given on the testing of 5- and 10-cell packs of nickel cadmium, silver cadmium, and silver zinc cells. Test parameters are outlined, and data sheets are included showing the end of discharge and end of charge voltage readings for each cell on each cycle recorded. Failure analysis data are also reported. M.G.J.

**N66-14288*#** Douglas Aircraft Co., Inc., Newport Beach, Calif. Astro Power Lab.
**SMALL FUEL CELL TO ELIMINATE PRESSURE CAUSED BY GASSING IN HIGH ENERGY DENSITY BATTERIES Progress Report, 30 Jun.–30 Sep. 1965**
H. Frank and M. P. Strier Sep. 1965 31 p refs
(Contract NAS5-9584)
(NASA-CR-68985; SM-48457-Q1) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Experimental miniature fuel cells were fabricated and tested in specially designed battery simulators to evaluate their use as a solution to gassing and pressure rise problems in sealed silver–zinc batteries. Three methods of incorporating these cells are described: the jack type for direct mounting on the battery vent tube; the screw type, in which the outer frame of the fuel cell is threaded so that it may be screwed into the top of the battery case; and the deep insert where the fuel cell is mounted deep inside the battery case and exposed directly to the gases which are evolved from the electrodes. Two cell configurations are shown. Life tests were conducted, and the effects of cell configuration and temperature on performance were assessed. Studies of hydrogen and oxygen mixtures established functionality for operation on mixtures containing up to 50% oxygen in the anode and up to

10% hydrogen in the cathode. Results also showed stable performance for 1600 hours, and effective operation at 40° C, where current output is approximately 200% that at 25° C, and 0° C where current output is 80% that at 25° C. M.G.J.

**N66-14292*#** Bunker-Ramo Corp., Canoga Park, Calif.
**RESEARCH STUDY OF SPACECRAFT AND AIRCRAFT MANUAL CONTROL SYSTEMS THEORIES Final Summary Report**
30 Apr. 1965 37 p refs
(Contract NASw-869)
(NASA-CR-68978) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Manual control system theories, performance measurement criteria, pilot reentry guidance and control, and pilot booster guidance and control were defined for the areas of spacecraft and aircraft system design, analysis, and synthesis. Three theoretical programs on optimal control were examined: Pontryagin's maximum principle; Bellman's dynamic programming; and Kalman's solution for linear systems, which was deemed most applicable to the problem. The inverse technique suggested by Kalman's solution was programmed for a high speed digital computer, and the results are tabulated. Performance measurement methodology and criteria are outlined, and a statement of current knowledge on pilot reentry capabilities and limitations was prepared. It was also mentioned that some 917 Russian documents on manual control and associated topics were reviewed. M.G.J.

**N66-14306#** Lockheed-California Co., Burbank.
**EVALUATION OF A MECHANICAL SERVO-ACTUATOR FOR FLIGHT CONTROL SYSTEMS**
O. A. Knuusi and W. R. Sage Oct. 1965 82 p refs
(Contract DA-44-177-AMC-232(T))
(LR-18636; USAAVLABS-TR-65-62; AD-623111) CFSTI: HC $3.00/MF $0.75

A prototype mechanical servo-actuator was tested under simulated loads to determine its suitability for use in powering flight control systems for helicopters. Tests included frequency response, step response, threshold, hysteresis, endurance, and emergency operation, and were compared with similar tests of a typical hydraulic servo. Recommendations are made regarding design changes for further investigation. Author (TAB)

# 04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

**N66-13423#** Joint Publications Research Service, Washington, D. C.
**PECULIARITIES OF GAS EXCHANGE STUDIES UNDER RAREFIED ATMOSPHERIC CONDITIONS**
N. A. Agadzhanyan and I. R. Kalinichenko 29 Nov. 1965 9 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 51, no. 7, Jul. 1965 p 793-798
(JPRS-33057; TT-65-33634) CFSTI: $1.00

Calculations on the indices of gas exchange values obtained from men and animals under rarefied atmospheric conditions are presented. The values of the per-minute volume of respiration must be reduced to a dry state, 0° C, and 760 mm mercury column in order to obtain the quantity of oxygen used, the amount of carbon dioxide liberated, and to determine the energy expended. For a normal oxygen supply to an organism, it is also necessary to calculate the percentage content of oxygen in the cabin under consideration of the moist inspired air. Calculations on the ratio of gases in the blood and in the cabin atmosphere showed that the partial pressure of carbon dioxide in alveolar air at an altitude of 7,000 m, with a normal oxygen supply, varies within the limits of 30 to 38 mm mercury column. Conditions of lower barometric oxygen pressure and physical labor dropped alveolar air pressure to 40 mm mercury column at altitudes of 9,000 to 11,000 m. G.G.

**N66-13431#** Los Alamos Scientific Lab., N. Mex.
**COMPUTER REDUCTION OF METABOLIC DATA OBTAINED FROM SCINTILLATION COUNTERS**
P. N. Dean 15 Nov. 1965 24 p refs
(Contract W-7405-ENG-36)
(LA-3298) CFSTI: $2.00

This report describes in detail the RTW series of computer programs written to analyze metabolic data. The programs calculate elapsed time between radionuclide administration and time of measurement, correct all data for changes in counting efficiency relative to measurements made on standards at zero time and for physical decay, if desired, and express the observed counting information as effective or biological retention at time of measurement. Author

**N66-13481*#** National Aeronautics and Space Administration, Washington, D. C.
**THE EFFECT OF LIGHT ON PLANT REPRODUCTION [UEBER DEN EINFLUSS DES LICHTES AUF DIE FORTPFLANZUNG DER GEWACHSE]**
Georg Klebs Dec. 1965 22 p refs Transl. into ENGLISH from Biologisches Centralblatt (Leipzig), v. 13, no. 21-22, 1893 p 641-656
(NASA-TT-F-9742) CFSTI: HC $1.00/MF $0.50 CSCL 06C

In dealing with the influence of light on the lower plants, the author first deals with the asexual reproduction of various algae, especially zoospore formation. Reproduction of various bryophytes seems to call for intense light to convert the necessary nutrients to substances that activate the dormant "rudimentum", an invisible material carrier. It is suggested that light may also alter certain physical relationships within the cell (e.g. the vacuole pressure). It is demonstrated that leaf and spore protenema act altogether differently towards light, with the former producing moss buds 8 days after exposure to light and the latter, in 4 to 5 weeks. The author draws a definite relationship between intense light and the formation of sex organs in the lower plants. Author

**N66-13484*#** National Aeronautics and Space Administration, Washington, D. C.
**FLUCTUATIONS IN HUMAN BODY TEMPERATURE WITH PARTICULAR CONSIDERATION ON THE EFFECT OF REVERSAL OF DAILY ACTIVITY PATTERNS [KORPERTEMPERATUR-SCHWANKUNGEN MIT BESONDERER RUKSICHT AUF DEN EINFLUSS, WELCHEN DIE UMKEHRUNG DER TAGLICHEN LEBENSGEWOHNHEIT BEIM MENSCHEN AUSUBT]**
Francis Gano Benedict and John Ferguson Snell Dec. 1965 41 p refs Transl. into ENGLISH from Arch. Physiol. (Germany), v. 90, 1902 p 33-72
(NASA-TT-F-9796) CFSTI: HC $2.00/MF $0.50 CSCL 06P

A group of metabolism and energy-exchange balance studies are conducted on 4 test subjects in a respiration calorimeter to determine the relationship between body temperature and the normal fluctuations of respiration, heartbeat, oxygen consumption, $CO_2$ and urine production and work

capability. The temperature curve recordings exhibited normal rhythm, with some deviation noted between rectal and axillary temperature. Muscular activity is shown to parallel body temperature; the temperature during nights after heavy muscular work being consistently lower than during nights after repose. The principal effect of fasting is lowering the degree of fluctuation of the curve. If heavy work was followed by fasting, the daily temperature fluctuation for long periods was reduced by approximately 0.6°C., and the average temperature by almost 1°C. No perceptible tendency toward a reversal of the temperature curve could be observed after ten consecutive days during which work was performed at night, and sleeping and resting done during the day. Author

**N66-13507#** Karolinska Institutet, Stockholm (Sweden).
**LIFE STRESS AND URINARY EXCRETION OF ADRENALINE AND NORADRENALINE**
Lennart Levi [1965] 15 p refs Presented at the 1st Intern. Conf. on Preventive Cardiology, Burlington, Vt., 1964 Submitted for Publication CFSTI: HC $1.00/MF $0.50

Results of experiments designed to investigate the extent various stimuli affect sympatho-adrenomedullary neurosecretory activity as reflected in the urinary excretion of adrenaline and noradrenaline are reported. The stress activity of 250 humans, exposed to emotional stimuli judged to be of slight to moderate intensity, was evaluated by measuring the output of catecholamines in the urine. The stimuli were selected from those we are most likely to encounter in daily life. More than 1600 urine samples were obtained and analyzed fluorimetrically. The primary aim of the experiments was to study the interrelationship between (1) type and intensity of stimuli as defined physically as well as psychologically, (2) reported subjective feelings, (3) observed behaviour, and (4) a number of autonomic and endocrine responses in different types of personalities and groups. M.R.W.

**N66-13520#** Argonne National Lab., Ill.
**SPACE PHYSIOLOGY: SOME RESULTS AND OUTLOOKS OF EXPERIMENTAL INVESTIGATIONS [KOSMICHESKAYA FIZIOLOGIYA NEKOTORYE ITOGI PERSPEKTIVY EKSPERIMENTAL'NYKH ISSLEDOVANII]**
O. G. Gazenko, V. V. Parin, V. N. Chernigovskii, and V. I. Yazdovskii Jul. 1965 12 p Transl. into ENGLISH of a report presented at the 10th Meeting of the All-Union I. P. Pavlov Physiol. Soc., Yerevan, USSR, 22–28 Oct. 1964
(ANL-TRANS-209) CFSTI: HC $1.00/MF $0.50

Data are summarized from physiological studies on 6 USSR astronauts who participated in space flights varying from one orbit of the earth to 119 hr in orbit between 1961 and 1963. The studies were made before, during, and for prolonged periods after space flight. Data are included on the effects of functional stress induced by transverse accelerations, defense responses, muscular stress, weightlessness, and the effects of conditions encountered during prolonged space flight on respiration, cardiovascular systems, working ability, psychological functions, and other parameters. Data from electroencephalograms, cardiograms, and electrooculograms are presented that supplement other observations on adaptation processes of humans during the conditions of space flight of a duration of approximately 2 days. NSA

**N66-13553*#** Minnesota Univ., Minneapolis.
**THE BACTERIOLOGY OF "CLEAN ROOMS" Progress Report, Apr. 1–Sep. 30, 1965**
G. S. Michaelsen [1965] 20 p refs
(Grant NSF-643)
(NASA-CR-68729) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Progress is reported in the four areas as follows: (1) identification of spore formers and other heat resistant microorganisms recovered from fallout strips in conventional aerospace clean room facilities; (2) experimental determination of dry heat resistance of the specifically identified spore formers with particular reference to the 135°C for 24 hrs cycle; (3) experiments related to human contact contamination of various representative materials and simulated components; and (4) the design and contruction of a small laminar downflow facility for future evaluation. Species identification of spore formers isolated are tabulated. Also, the results of the determination of thermal death times of specific clean room spore formers are given. Microbial contamination detected on component materials after handling by groups of four persons are also tabulated. The room for the laminar downflow facility will be 8 ft by 10 ft with a 4 ft by 4 ft entryway. The room will be constructed and in operation in the near future. E.E.B.

**N66-13560*#** Naval School of Aviation Medicine, Pensacola, Fla.
**PERCEPTION OF THE VISUAL HORIZONTAL IN NORMAL AND LABYRINTHINE DEFECTIVE SUBJECTS DURING PROLONGED ROTATION**
Brant Clark and Ashton Graybiel 8 Jul. 1965 10 p refs *Its* Rept.-116
(NASA Order R-93)
(NASA-CR-68659; NSAM-936) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Five normal and nine labyrinthine defective men were studied in a Slow Rotation Room which produced a change in resultant force of 20° on them. The men faced in the direction of rotation and at one minute intervals set a luminous line to the perceived horizontal in darkness for one hour. The results for the normal men confirmed an earlier study showing no systematic change in the perception of the visual horizontal after an initial lag effect. In contrast, the labyrinthine defective men showed a smaller, rapid, and then a gradual change in the perception of the visual horizontal throughout the one hour of constant rotation. At the end of one hour there was no significant difference between the two groups. These results are discussed in terms of a differential weighting of the synergistic information available to the two groups. Author

**N66-13594#** Massachusetts Inst. of Tech., Cambridge.
**METABOLIC STUDIES OF ENERGY DENSE COMPOUNDS FOR AEROSPACE NUTRITION**
S. A. Miller, H. A. Dymsza, S. R. Tannenbaum, and S. A. Goldblith Wright-Patterson AFB, Ohio, AMRL, Aug. 1965 51 p refs
(Contract AF 33(657)-7660)
(AMRL-TR-64-121; AD-623615) CFSTI: HC $3.00/MF $0.50

The aim of these studies was the development of model compounds with which information useful in understanding energy metabolism might be obtained to aid in development of food for space travel. Seven-month studies feeding rats with 1,3-butanediol have been completed. The results of these studies confirm the utilization of this compound as a energy source. Measurement of a number of metabolic parameters at the completion of the study support the contention that 1,3-butanediol is probably metabolized through carbohydrate rather than fat pathways. Metabolism studies with 2,4-dimethylheptanoic acid labeled with $C^{14}$ in the alpha methyl group indicate that this compound as predicted is oxidized through propionate. Design and construction details of the direct animal calorimeter are presented. Results of a limited number of studies with rats fed various diets indicate that the device fulfills its design functions. Author (TAB)

psychologic stresses during this phase of training and provide useful baselines for the evaluation of airsickness in student aviators. Author (TAB)

**N66-13700#** Naval School of Aviation Medicine, Pensacola, Fla.

**AIRSICKNESS IN STUDENT AVIATORS**

Gary J. Tucker, David J. Hand, Asa L. Godbey, and Roger F. Reinhardt 12 Jul. 1965 12 p refs *Its* Rept.-1 (NSAM-939; AD-622777) CFSTI: HC $1.00/MF $0.50

One thousand sixty-seven student Naval aviators were rated at the end of each flight during the presolo and basic acrobatic phase of training by the flight instructor for the presence or absence of nausea or vomiting during the flight. To be so rated, the airsickness had to be severe enough to cause inability to control the aircraft. In this manner, a profile of the patterns of airsickness was obtained on each student over the course of the primary flight training. The incidence of this type airsickness was 17.6 per cent (188 students out of 1,067). Correlations between incidents of airsickness per student and their ground school grades and flight grades were not statistically significant. There are three main periods during which the majority (79 per cent) of airsickness occurs. These are the initial three training flights, the seventh, and the first three dual acrobatic flights. These periods are closely correlated with the various and different peaks of physiologic and

**N66-13758#** Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

**ELECTRICAL AND ELECTRONICS ENGINEERING RESEARCH] Second Semiannual Research Summary, Jan.–Jun. 1965**

[1965] 109 p refs (AD-622202) CFSTI: HC $6.00/MF $1.25

Contents: Medical and life sciences, biological systems and electrophysiology; control and information systems, automata and artificial intelligence; electric power systems and energy conversion; electromagnetic fields; electronic systems research laboratory; materials. TAB

**N66-13789** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CERTAIN PROBLEMS OF PHYSIOLOGICAL MEASUREMENT IN INTERPLANETARY FLIGHTS**

R. M. Bayevskiy *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 223–236 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

On the basis of an analysis of systems aboard the Vostok-series spacecraft, the problem of physiological measurements in interplanetary flight is discussed. The basic tasks of physiological measurements include manipulative medical monitoring; scheduled medical examinations, including diagnosis of illnesses; and medical scientific research. Transmission of the physiological information to the earth represents a special problem. Medical monitoring should take place only occasionally during the flight and with the use of a minimum of sensors and electrodes, with transmission of the information via intracabin radio link. Routine and diagnostic examinations should be conducted with the aid of a computer on board the vehicle. Studies with effective coding of generalized data acquire great importance. Certain aspects of biological control are examined as they apply to interplanetary flight. Author

**N66-13790** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**OCCURRENCE OF DOMINANT LETHALS IN DROSOPHILA UNDER THE INFLUENCE OF VIBRATION, ACCELERATION AND γ IRRADIATION**

G. P. Darfenov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 237–254 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

This paper presents the results of laboratory studies of the influence of vibration, acceleration, γ-irradiation and the combined effects of these factors on the occurrence of dominant lethals in the primordial cells of Drosophila males. The study was conducted to analyze the nature of the effect obtained in Drosophila in a series of space flights. It was shown that vibration and acceleration may influence the final result on indication of a biological effect of ionizing radiation by means of a given test, although in all probability they produce nonnucleic modifications. Author

**N66-13791** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**INFLUENCE OF VIBRATION ON BONE-MARROW CELL DIVISION**

G. L. Pokrovskaya, L. A. Belyayeva, and A. V. Golovkina *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 255–265 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Changes in cell nuclei and suppression of mitotic activity were observed when mice were subjected to various periods of vibration. Vibrations at 35 cycles per sec did not suppress cell division until the tenth day after vibration was begun, whereas at the 70-cycle frequency there is some suppression following vibration for 60 min. In the latter, there is an increase in rate of division on the tenth day, but this increase is lower than that for the control group. Vibration at 70 cycles for 15 min raises incidence of disturbance in cell nuclei, an increase which persists for ten days. Division abnormalities are basically due to chromosome adhesion. Tables summarize frequency of chromosome abnormalities occurring from various periods of vibration. M.W.R.

**N66-13814#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**INVESTIGATION OF CHINCHILLA VESTIBULAR SYSTEM RESPONSE TO VERTICAL LINEAR ACCELERATION**

Daniel William Buehler and Lucious Calvin Butt (M.S. Thesis) [1965] 41 p refs (GE/EE/65-6; AD-622992) CFSTI: HC $2.00/MF $0.50

Electronystagmus measurement of vertical eyeball displacement was used to investigate chinchilla vestibular response to vertical sinusoidal accelerations which varied incrementally from 0.5 to 20 cps in frequency and from 0.5 to 3 g, peak-to-peak, in amplitude. Frequency diagrams, plotted from data obtained from seven animals, indicated that the magnitude of the response of the vestibular apparatus is a function of frequency and g level, but that the phase lag of the response is a function of frequency only. Within the experimental frequency and acceleration limits, no resonance phenomena or hysteresis effect of vestibular response was found. Author (TAB)

N66-13830*# Chicago Univ., Ill. Dept. of Biophysics.
**INVESTIGATIONS IN SPACE-RELATED MOLECULAR BIOLOGY, INCLUDING CONSIDERATIONS OF THE MOLECULAR ORGANIZATION OF EXTRATERRESTRIAL MATTER Technical Progress Report**
Humberto Fernandez-Moran [1965] 31 p refs
(Grant NsG-441-63)
(NASA-CR-68844) CFSTI: HC $2.00/MF $0.50 CSCL 06C

It is reported that development work continued on the improvement of preparation techniques and instrumentation for high resolution electron microscopy. This included further application of low temperature methods, and the design of new types of high resolution cryoelectron microscopes. These are immersed in liquid helium cryostat, and use superconducting electromagnetic lenses and image intensifiers with electronic readout. It is also reported that correlated electron microscopic and biochemical investigations were carried out on mitochondrial membranes, membrane derivatives, hemocyanins, and on associated enzyme and multienzyme complexes. Participation in the Luster sounding rocket experiment to sample lunar dust near the earth consisted of designing and constructing a special high vacuum container for transfer of the sampling surfaces which collect extraterrestrial material. C.T.C.

N66-13833*# Naval School of Aviation Medicine, Pensacola, Fla.
**A COMPARISON OF EFFECTIVENESS OF SOME ANTIMOTION SICKNESS DRUGS USING RECOMMENDED AND LARGER THAN RECOMMENDED DOSES AS TESTED IN THE SLOW ROTATION ROOM**
Charles D. Wood, Ashton Graybiel, and Robert S. Kennedy 16 Aug. 1965 12 p refs Joint report with NASA *Its* Rept.-121
(NASA Order R-93)
(NASA-CR-68858; NSAM-945) CFSTI: HC $1.00/MF $0.50 CSCL 06O

In a previous study the recommended doses of some antimotion sickness drugs were tested on a human centrifuge. In the present study increased doses of these same drugs were used to investigate any possible increase in efficiency. Twice the dose of hyoscine (1.2 mg) failed to increase its effectiveness; however, when it was used in combination with d-amphetamine the total number of tolerated head movements exceeded the sum of that with these drugs when they were tested alone. A marked increase in effectiveness of d-amphetamine (20 mg) was noted over that in the earlier study in which a dose of 10 mg was used. Meclizine (Bonamine 150 mg), thiethylperazine (Torecan 30 mg), trimethobenzamide (Tigan 750 mg), and prochlorperazine (Compazine 15 mg) all were less effective than in the previous study when one third of these doses was used. The combination of hyoscine and d-amphetamine was the most effective drug, followed by hyoscine, d-amphetamine, and meclizine, in that order. Author

N66-13854# Atomic Energy Commission, New York. Health and Safety Lab.
**HEALTH AND SAFETY LABORATORY ANALYTICAL MANUAL**
Aug. 1965 100 p Revised
(NYO-4700, Suppl. 2) CFSTI: HC $4.00/MF $0.75

Additions and corrections made to the Health and Safety Laboratory Manual of Standard Procedures include: analytical data on fission yield and fission product decay; sampling principles, sample handling, and sampling types; the application of air sampling in the evaluation and control of the occupational environment; principles of air sampling; radiochemical determination of Pu and $^{226}Ra$ in water, urine, and feces; radiochemical determination of Pu in air filters; the determination of $^{90}Sr$ and $^{137}Cs$ in large volume sea water samples; and specifications for polyethylene syringe bottles, improved plating cells, and microsorbent filter paper. Author (NSA)

N66-13897# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
**FATIGUE IN AVIATION ACTIVITIES**
Stanley R. Mohler Mar. 1965 19 p refs
(AM-65-13; AD-620022) CFSTI: HC $1.00/MF $0.50

The report gives a comprehensive survey of work in the field of aviation fatigue. Both current work still in process and earlier work are surveyed. The nature of fatigue itself is discussed, along with all possible factors that contribute to both physical and mental fatigue. Topics covered include flight-time limitations, indicators of excessive fatigue, new developments related to intercontinental flights and Forest Service flights, and the author's detailed comments and recommendations. Author (TAB)

N66-13899*# National Aeronautics and Space Administration, Washington, D. C.
**SIGNIFICANT ACHIEVEMENTS DURING SIX YEARS OF SPACE BIOSCIENCE RESEARCH AND APPLICATIONS, 1958–1964**
Jan. 1965 157 p refs
(NASA-TM-X-57051) CFSTI: HC $5.00/MF $1.00 CSCL 06K

Research progress in NASA's space biology program is summarized. A broad research and flight mission program in space biology was developed which includes development of life detection experiments and a concept for an automated biological laboratory for planetary exploration of life; a biosatellite program including scientific experiments to study the biological effects of weightlessness, radiation combined with weightlessness, and removal from the Earth's rotation; a recoverable biosatellite spacecraft system; and the supporting research and technology required for these flight missions as well as biological support for manned space flight. Monkeys and chimpanzees were flown in sub-orbital and orbital flights to test systems and their safety before flight of astronauts. In the exobiology field, progress was made in biosynthesis of organic life-related materials and lifelike objects and the possible origin of life, study of organic constituents of meteorites, development of life detection instruments, and a new concept of integrated life detection for unmanned spacecraft for Martian exploration. New spacecraft sterilization methods were developed. Earth organisms were subjected to simulated planetary environmental conditions and the growth or survival established. R.N.A.

N66-13907# California Univ., Berkeley. Lawrence Radiation Lab.
**FREE RADICAL INDUCED IN ENZYMES BY ELECTRONS AND HEAVY IONS**
Thormod Henriksen 23 Aug. 1965 27 p refs Presented at Workshop Conf. on Space Radiation Biol., Berkeley, Calif., 7–10 Sep. 1965
(Contract W-7405-ENG-48)
(UCRL-16358; Conf-650924-2) CFSTI: HC $2.00/MF $0.50

Free radicals produced in three enzymes, ribonuclease, lysozyme, and trypsin, exposed to various types of radiation, were studied by ESR spectroscopy. The enzymes were irradiated in the solid state, in vacuum, at different temperatures in the range 77 to 330° K. For all three enzymes it was found that the resonance spectra at room temperature can be ascribed mainly

to sulfur radicals and to a radical in which the unpaired electron is localized on an α-carbon atom in the protein backbone. However, another unidentified resonance was found in all three enzymes. The yield of secondary enzyme radicals increased with increasing irradiation temperature. Good correlation was found between the production of secondary radicals and the inactivation of the three enzymes. NSA

**N66-14020#** General Foods Corp., White Plains, N. Y. Technical Center.

**FUNDAMENTAL ASPECTS OF MEAT TEXTURE Final Report, 15 Jun. 1961–15 Mar. 1965**

D. De Felice, Alina Szczesniak, D. Gardner, E. Farkas, and K. Sloman Natick, Mass., Army Natick Labs., Aug. 1965 128 p refs

(Contract DA-19-129-QM-1844)

(FD-17; AD-622087) CFSTI: HC $4.00/MF $1.00

The report summarizes work done over a four year period on the suitability of the General Foods Texturometer (I) for meat texture description and its comparision with the Warner-Bratzler Tenderometer (II) and the Kramer Shear Press (III). Parameters of hardness, cohesiveness, elasticity, chewiness and water release measurable on I were found applicable to fresh and freeze-dehydrated meats (beef, pork, turkey, fish comminuted meat). Correlations of I with panel and with II and III varied in significance depending on variables incorporated into the sample design and were related to the range of values covered. All three instruments correlated highly significantly with sensory tenderness and with each other; however, they could not be considered good predictors of tenderness. None correlated consistently with sensory juiciness. Sensory overall texture ratings could be described in terms of tenderness and juiciness. When several parameters were combined, I was superior to the other instruments in that it could account for up to 90% variation in sensory overall texture. However, the nature of equations and contributions of individual parameters varied depending on sample set. All three instruments were able to differentiate between important sample processing variable incorporated into the experimental design. In general, I appeared to be the most, and II the least sensitive to defining these differences. Author (TAB)

**N66-14029#** Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

**INTERDISCIPLINARY MEASUREMENT OF HUMAN PERFORMANCE UNDER LOW AND ZERO GRAVITY CONDITIONS**

Duane Frank Kasten [1964] 15 p refs

(AD-620931) CFSTI: HC $1.00/MF $0.50

A discussion is presented of research techniques used by experimental psychologists, anthropologists, physiologists, and engineers in studying human performance under low and zero gravity conditions. TAB

**N66-14037#** American Foundation for Biological Research, Madison, Wis.

**DETERMINATION OF THE AMOUNTS OF ICE FORMED IN THE FEET OF MICE FROZEN AT VARIOUS TEMPERATURES**

B. J. Luyet, C. Kroener, and R. Williams Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1964 19 p refs

(Contract AF 41(657)-343)

(AAL-TDR-63-29; AD-610407) CFSTI: HC $1.00/MF $0.50

The amount of ice formed in amputated feet of mice frozen at various temperatures was found, in 26 calorimetric determinations, to vary from 29.6% of the total weight at −1.5C to 46.7% at −9.5C. These figures represent, respectively, 46% and 72.5% of the water content of the limb. The average deviations from the mean percentage of ice per total weight were of the order of three units. The proportions of water frozen at given temperatures, after establishing equilibrium of ice formation, are appreciably lower in these experiments than in those of Lovelock and Smith on the hamster. There is close similarity in the ratios of electric capacitances of nonfrozen and frozen paws of mice, in the cases of amputated limbs, attached limbs in dead animals and attached limbs in living animals. This similarity justifies the use of calorimetric determinations made on amputated limbs to estimate the amounts of ice formed in living tissues or organs frozen under the same conditions, as furnished by the ratios of capacitances, after the relationship between these ratios and the calorimetric data is established. Author (TAB)

**N66-14089#** Association Claude Bernard, Paris (France).

**IMMUNOLOGICALLY COMPETENT CELLS [LES CELLULES IMMUNOLOGIQUEMENT COMPETENTES]**

G. Mathe, J. L. Amiel, C. Brezin, and C. Choquet Brussels, EURATOM, Aug. 1965 20 p In FRENCH; ENGLISH summary European Atomic Energy Community, Brussels (Belgium).

(Contract EURATOM-032-64-1 BIOF)

(EUR-2469.f) CFSTI: HC $1.00/MF $0.50

The subject of our research is immunologically competent cells. We have shown that in the irradiated adult animal the ability to respond to an antigenetic stimulus following irradiation depends upon the number of lymphoid cells contributed by the graft. Immunization against a heterologous protein is nil if the graft is less than $10^5$ cells, but normal if it is at least $2.5 \times 10^7$ cells. However, a graft of $2.5 \times 10^7$ ganglionic cells does not cause immunization of an irradiated host if it comes from previously irradiated donors who had received $10^5$ ganglionic cells or less and been subjected immediately after irradiation to the same antigenic stimulus. The induction of an inbalance in the antigenic stimulus/number of immunologically competent cells ratio by a sufficient reduction of the denominator thus produces cell level, in an adult organism, lasting, graft transmissible and specific modifications. We have also shown that the injection into irradiated recipients of semi-allogenic peritoneal macrophages, which in themselves are inactive, considerably reinforces the immunizing reaction of a graft of semi-allogenic thymic cells against the host. Author

**N66-14092#** Institut Pasteur, Paris (France). Service de Radiobiologie et de Cancerologie.

**INTERACTION OF RADIATION WITH DEOXYRIBONUCLEIC ACIDS (SECOND YEAR OF STUDY) [INTERACTIONS DES RADIATIONS ET DES ACIDES DESOXYRIBONUCLEIQUES (DEUXIEME ANNEE D'ETUDE)]**

R. Latarjet Brussels, EURATOM, Aug. 1965 6 p In FRENCH

(Contract EURATOM-030-63-3 BIOF)

(EUR-2471.f) CFSTI: HC $1.00/MF $0.50

The effects of X- and gamma-rays on polynucleotides (U, C, A) were further studied in the presence and absence of oxygen; the quantum yields were measured in respect of the destruction of the bases and of the breaking of the phosphodiester chains. The consequences to the coding activity in the Niremberg system were measured. These ionizing-radiation effects were compared with those of nitrogen mustard. Lastly, the part played by free radicals in these reactions was partially defined by electronic paramagnetic resonance measurements. The studies were extended to cover the effects of X-rays on Pneumococcus-transforming DNA, where a "marker rescue" phenomenon was discovered, and on DNA exchanges between growing bacteria, and, lastly, on the bacterium/bacteriophage

system in lysogenic bacteria. At the same time, research went forward on radioactive disintegration effects on DNA constituents (thymidine) and on certain cellular nucleic acids; in particular, the induction of a mutation aimed at radiation-resistance in yeast under the effect of P-32 disintegrations was analysed in biochemical and genetic terms. This radiation-resistance is associated with the existence of abnormal meiosis. In conclusion, the present report describes the progress of the studies of radiation effects on bacterial genetic recombination. Author

**N66-14097#** Atomic Weapons Research Establishment, Aldermaston (England).
**A PRELIMINARY EVALUATION OF THE BIOLOGICAL MEASUREMENTS ON OPERATION ROLLER COASTER (JOINT US/UK EXPERIMENTS)**
K. Stewart, D. M. C. Thomas, J. L. Terry (DASA, Washington, D. C.), and R. H. Wilson (Rochester Univ.) Jul. 1965 34 p refs
(AWRE-O-29/65) HMSO: 5s

The deposition and retention of plutonium in burros, sheep, and dogs were measured and compared with the quantities of plutonium collected by cascade impactor samplers. The animals were exposed to the cloud resulting from the nuclear explosion; details on animal exposure positions, and relationship of animal species to positions and air samplers are diagrammed. In evaluating the results, comparisons were made of the initial lung deposition with the size distribution of the aerosol inhaled, and of the mean deposition per unit lung weight or body weight for the three species. Lung clearance patterns, including translocation to other parts of the body, were also considered. Data on lung deposition and retention are tabulated for each animal. Findings indicate that the similarity between initial deposition in the animals and that expected for man can be applied in assessing the hazard to man. It was also found that simple relationships, between the median value for the initial deposition and the ratio of the breathing rate to the body and lung weights, confirm the view that the results obtained with the three animal species are comparable and compatible with the existing data for man. M. J.

**N66-14160*#** National Aeronautics and Space Administration, Washington, D. C.
**AEROSPACE MEDICINE AND BIOLOGY Bibliography with Indexes, Nov. 1965**
Dec. 1965 129 p refs
(NASA-SP-7011(18)) CFSTI: HC $1.00/MF $1.00 CSCL 06

A selection of annotated references to unclassified reports and journal articles relating to aerospace medicine and biology that were introduced into the NASA information system during November, 1965 is given, along with subject, author, and corporate source indexes. Among the subject areas covered are the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. L.S.

**N66-14197#** Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
**EQUATIONS OF MOTION IN CIRCULAR MOTION TERMS FOR THE LIMACON Report No. 3**
John A. Weaver 30 Jun. 1965 35 p refs
(NADC-ML-6507; AD-623486) CFSTI: HC $2.00/MF $0.50

Equations of motion for the limacon curve are developed for use in the study of vestibular function as related to vehicular motion. The equations are transformed from polar coordinate terms given in terms of the radius vector and the polar angle to circular motion terms given in terms of the radius of curvature and central angle of the circle of curvature. This permits comparison of vestibular function studies done in vehicles with those done on human centrifuges. Equations were derived from defining the accelerations of interest in studying vestibular effect on humans moving along the limacon. While conclusions are specific to the immediate program, basic approaches were developed for defining equations of the form $\rho = f(\theta)$ in terms of circular motion. Author (TAB)

**N66-14207#** Naval Radiological Defense Lab., San Francisco, Calif.
**ANTIBODY PLAQUE-FORMING CELLS: KINETICS OF PRIMARY AND SECONDARY RESPONSE**
J. S. Hege and L. J. Cole. 2 Sep. 1965 28 p refs
(USNRDL-897; AD-623108) CFSTI: HC $2.00/MF $0.50

Numbers of Jerne plaque-forming cells per spleen, serum hemolysin concentrations, and the degree of resistance of the serum hemolysin to degradation by 2-mercaptoethanol have been determined in adult CBA and C3D2F1 mice as functions of time following primary or secondary intravenous sensitization with $4 \times 10^8$ sheep erythrocytes. The characteristic secondary response yields fewer PFC and lower serum antibody concentrations than the primary response. When an adequate time interval (9 weeks or more) elapses between primary and secondary antigen injections, the magnitude of the secondary response begins to approach that of the primary. Primary serum hemolysin is mercaptoethanol sensitive (19S immunoglobulin) while secondary serum hemolysin is largely mercaptoethanol resistant (7S immunoglobulin). Generation times of 7 and 9 hours are obtained for plaque-forming cells during the first 4 days of the primary response. A mathematical model is presented which relates numbers of antibody forming cells to serum hemolysin concentrations. Using the model, together with available experimental data, it is concluded that the great majority of the cells producing 7S hemolysin probably are not detected by the Jerne technique, as applied to the spleen. Author (TAB)

**N66-14261#** Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany).
**INVESTIGATIONS ON STRESS IMPOSED ON AIRCREW IN CIVIL JET AIRCRAFT DURING LONG-RANGE FLIGHT: REPORT ON RESULTS ON THE NORTHERN ATLANTIC ROUTE [UNTERSUCHUNGEN ZUR BELASTUNG DES BORDPERSONALS AUF FERNFLUGEN MIT DUSENMASCHINEN: BERICHT UBER DIE ERGEBNISSE AUF DER NORDATLANTIKROUTE]**
H. Brüner, K. E. Klein, and S. Ruff Oct. 1965 67 p refs In GERMAN; ENGLISH summary
(DLR-FB-44; DVL-469) CFSTI: HC $3.00/MF $0.75

Investigations were performed on the stress level which affects the aircrews of airlines during long distance flights on jet aircraft. The results form the basis for evaluating the physiological work load on the investigated flight routes, and they yielded new knowledge on the influence of strenuous flights during certain day/night hours upon flight safety. Author

**N66-14315#** Systems Research Labs., Inc., Dayton, Ohio.
**INTEGRATED DATA COLLECTION, MONITORING, CONVERSION, AND ANALYSIS SYSTEM FOR PSYCHOPHYSIOLOGICAL STRESS RESEARCH Final Report, 1 Jul. 1961–31 Dec. 1963**
D. H. Brand, R. M. Linhart, and C. A. Burns Wright-Patterson AFB, Ohio, AMRL Jun. 1965 103 p refs
(Contract AF 33(657)-9810)
(AMRL-TDR-64-64; AD-623128) CFSTI: HC $4.00/MF $0.75

The details involved in designing and executing a large-scale psychophysiological stress experiment are summarized. Design criteria and changes in experimental processes necessitated by preliminary, concurrent studies as well as instrumentation and data conversion problems are also presented. Emphasis is placed on description of the data processing routes, each of which consisted of analog tape formating, analog to digital conversion, data reduction and editing, and data analysis techniques. Flow diagrams, computer program writeups, and examples of pictorial output formats for general, automatic, biological data handling utility are appended. Author (TAB)

**N66-14320#** School of Aerospace Medicine, Brooks AFB, Tex.
**TRAINING THE VESTIBULE FOR AEROSPACE OPERATIONS. CENTRAL CONTROL OF VESTIBULAR FUNCTION**
Kent K. Gillingham Sep. 1965 31 p refs *Its* Rev. 8-65
(AD-623676) CFSTI: HC $2.00/MF $0.50

Emphasis is placed on the evidence that the vestibular system is capable of being trained. One aspect of the mechanism by which training can be wrought, the vestibular efferent system, is discussed. On the basis of the understandings of the vestibular system, of spatial disorientation, and of motion sickness, one should be able to deal with operational vestibular problems by using the tools of education and training. It remains to be determined whether the most effective and economical approach to vestibular training lies in more effective didactics, more sophisticated utilization of the suppression mechanism, the actual changing of erroneous vestibular responses into correct responses, or any combination thereof. Whatever the method, the need for vestibular training persists as long as spatial disorientation wastes the lives of aircrew and motion sickness compromises military effectiveness. Author (TAB)

# 05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

**N66-13331*#** American Inst. for Research, Pittsburgh, Pa. Inst. for Performance Technology.
**HUMAN FACTORS INFORMATION REQUIREMENTS FOR SPACE SYSTEM DEVELOPMENT Final Report**
James W. Altman Jun. 1964 173 p refs
(Contract NASr-194)
(NASA-CR-68616) CFSTI: HC $5.00/MF $1.00 CSCL 05E

Life scientists, human factors engineers, and other system development personnel were interviewed in a survey of practices in existing human factors programs in order to obtain data for long-term requirements in space system development. A literature survey and an analysis of system development decisions were also made. Individual requirements were organized into the following areas: (1) basic data generation and dissemination, (2) definition and control of the human factors process, (3) function description and processing, (4) human factors design, and (5) design assessment. Of the 74 individual requirements identified in these categories, six are general to all areas of human factors activity and 68 are specific to one of eight areas. For each of the eight areas, there is a requirement to develop integrated procedures in support of more effective activity; the other 60 requirements are specific state-of-the-art improvements in the different areas. An overview of requirements is presented, and 14 requirements are discussed in detail. A bibliography is appended. M.W.R.

**N66-13516*#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**REPORT OF THE NASA SEMINAR ON PILOT-VEHICLE SYSTEMS IDENTIFICATION**
Jerome I. Elkind 1 Mar. 1964 87 p refs Seminar held at Ames Res. Center, May 1963 *Its* Rept.-1102
(Contract NASw-668)
(NASA-CR-68701) CFSTI: HC $3.00/MF $0.75 CSCL 05H

A discussion, from a seminar held at the NASA Ames Research Center, on pilot-vehicle system identification is presented. The seminar focused on the comparison of methods for determining human pilot dynamic response characteristics. It is shown how the paradigm of multiple regression analysis serves as a basis for comparing all of the commonly used techniques for identifying human pilot dynamic response characteristics: cross-correlation analysis, cross-spectral analysis, orthogonalized exponential analysis, and differential equation coefficient methods. Expressions for the expected values and the variances of the measures obtained using these techniques are derived. The different analysis techniques are described and compared with respect to accuracy and precision. A method for obtaining the coefficients of the differential equation for a system from regression coefficients is given. The problem of using only signals circulating within the feedback loop to determine the open-loop describing function of the human operator is discussed. M.R.W.

**N66-13595#** Tech Development, Inc., Dayton, Ohio.
**THE DEVELOPMENT OF GAS AND LIQUID CIRCULATING DEVICES FOR MANNED SPACE ENCLOSURES Technical Report, Feb. 1964–Feb. 1965**
Joseph Flatt Wright-Patterson AFB, AMRL, Aug. 1965 31 p
(Contract AF 33(615)-1251)
(AMRL-TR-65-128; AD-623161) CFSTI: HC $2.00/MF $0.50

An analytical and experimental investigation was conducted to determine the feasibility of utilizing the energy available in breathing oxygen, when expanded from storage pressure to breathing pressure, to power two types of pumping devices; (1) an oxygen-circulating blower, and (2) a water-circulating pump. With an oxygen weight flow of 2.65 lb/hr and an ambient environmental pressure of 5 psia, the required performance of 5 cfm at 10 inches $H_2O$ static pressure for the circulating blower and 1 lb/min at a back pressure of 10 inches $H_2O$ for the water pump were met. Performance considerably in excess of the requirement was obtained for the water pump. Both units were powered by single-stage impulse turbines and weighed less than the 1-pound requirement. Both units operated reliably without mechanical malfunction and appear to be suited for manned aerospace enclosures. Author (TAB)

**N66-13596#** Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
**MANUAL CONTROL OF A PULSE-FREQUENCY MODULATED REACTION CONTROL**
John P. Hornseth Aug. 1965 16 p refs
(AMRL-TR-65-145; AD-623558) CFSTI: HC $1.00/MF $0.50

A manual pulse-frequency modulated reaction control is a control with fixed pulse width, fixed pulse amplitude, and manual control of pulse frequency. For such a control, it is possible to maintain a constant reactive force per pulse for various combinations of pulse widths and pulse amplitudes. The controlled element was a one-dimensional second order system. A

semirandom sequence of three step voltages was used to displace a spot on a CRT. Subjects were required to recenter the spot as fast as possible. Manual control performance was tested under three levels (low, middle, high) of control output gain. Three pulse width–pulse amplitude combinations were tested at the low and high control output gain levels and four pulse width–pulse amplitude combinations for the middle control output gain level. Three subjects were tested under all conditions. Performance measures obtained were: integrated absolute error, integrated absolute fuel consumption, and integrated absolute stick motion. The results of this study indicate that (1) changing pulse width and pulse amplitude, but keeping control output gain fixed, does not effect manual performance; but that (2) changing control gain does. Author (TAB)

**N66-13689#** Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
**REINFORCEMENT-TEST SEQUENCES IN PAIRED-ASSOCIATE LEARNING**
Chizuko Izawa and William K. Estes 1 Aug. 1965 83 p
(Contract Nonr-225(73)
(TR-76; AD-622248) CFSTI: HC $3.00/MF $0.75

Learning of paired-associate items was studied in relation to different repetitive sequences of reinforced (R) trials and test (T) trials. One purpose was to obtain evidence as to whether either learning or forgetting occurs on unreinforced T trials; a second was to adduce principles bearing on the problem of optimal programming of R and T trials. The four training conditions were: (1) R T R T ...; (2) R R T R R T ...; (3) R T T R T T ...; (4) R R T T R R T T .... Five items were assigned to each condition and the sequences were repeated till a criterion of learning was reached. Two groups of 50 subjects were run; one with nonsense syllable–number pairs and one with nonsense syllable–word pairs. Performance on tests given successively without intervening reinforcement showed no significant change in correct response probability—suggesting that neither learning nor forgetting occurred on T trials per se. The course of learning was, however, affected to a major extent by the ratio of T's to R's and by their arrangement in the various repetitive sequences. Learning curves plotted in terms of error proportion on the first T following the n(th) R trial lined up in the order: Condition 3 (lowest), 1, 4, 2. Author (TAB)

**N66-13711#** Atomic Weapons Research Establishment, Aldermaston (England).
**THE HAZARDS TO THE HUMAN EAR FROM SHOCK WAVES PRODUCED BY HIGH ENERGY ELECTRICAL DISCHARGES**
Pamela M. Golden and R. Clarke London, HMSO, Aug. 1965 24 p refs
(AWRE-E-1/65) HMSO: 6s

The blast pressures developed by a high energy electrical discharge as received by a transducer mounted in a large baffle normal to the blast were measured and compared with those received by a model ear. It is shown that the pressures developed at the drum of the ear are in excess of those in air and can cause damage to the ear unless precautions are taken. There is a high proportion of large amplitude noise at audio frequencies present which many protective devices transmit. Measurements with samples of these show that there is some attenuation of pressure and it is probable that a muff protector is more efficient than an ear defender which consists of a solid plug with a small axial air channel. Author

**N66-13831*#** Teledyne Systems Corp., Hawthorne, Calif.
**RESEARCH IN ADVANCED CONCEPTS IN BIOTECHNOLOGY, HUMAN ANALOGS, AND BIONICS** Final Report
30 Oct. 1964 324 p refs
(Contract NASw-780)
(NASA-CR-68777) CFSTI: HC $7.00/MF $2.00 CSCL 06D

Research has been conducted into the biotechnology of three of the subsystems of man: an energy input subsystem, a distribution and control subsystem, and an energy output subsystem. Human analogs are developed by the utilization of the man–machine methodology. Bionic applications using human analogs are made for each of the subsystems studied, and a bionic system, which includes an application from each of these subsystems, is suggested. Author

**N66-13826#** Aviation Safety Engineering and Research, Phoenix, Ariz.
**PASSENGER/CREW TEST LOAD SIMULATION CRITERION**
D. F. Carroll and H. G. C. Hennеberger Jun. 1964 68 p refs
(Contract FA-WA-4459)
(FAA-ADS-20)

Criteria as may be required in the future for appropriate body blocks, anthropomorphic dummies, and instrumentation for use in static and dynamic testing of civil aircraft seat systems is provided. Anthropomorphic data on airline travelers and flight crews is given along with specific recommendations for standard human body load simulators and minimum instrumentation requirements. Author

**N66-13972#** Applied Psychological Services, Wayne, Pa. Science Center.
**COMMUNICATIONS AS A MEASURABLE INDEX OF TEAM BEHAVIOR** Final Report
Philip Federman and Arthur I. Siegel Port Washington, N. Y., Naval Training Device Center, Oct. 1965 88 p refs
(Contract N61339-1537)
(NAVTRADEVCEN-1537-1; AD-623135) CFSTI: HC $3.00/MF $0.75

The relationship between anti-submarine (ASW) helicopter team performance and the content and flow of communications within the team during a simulated attack was investigated. Fourteen distinct communications variables were found to be correlated with the objective performance measurement criterion (miss distance) employed. The factors were named 'probabilistic structure,' 'evaluative interchange,' 'hypothesis formulation,' and 'leadership control.' The findings of this study suggest the value of developing scaled performance measures as diagnostic devices for evaluating inflight crew behavior, as predictors of success in the Fleet, and as end-of-course measures. The implications of the findings for training devices and training device problems are developed. Author (TAB)

**N66-13978#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
**EGRESS FROM A SINGLE PLACE CREW STATION IN A WEIGHTLESS ENVIRONMENT** Final Technical Report, 1 Feb. 1964–1 Apr. 1965
Edward O. Roberts Sep. 1965 40 p refs
(AFFDL-TR-65-148; AD-623120) CFSTI: HC $2.00/MF $0.50

The report presents the results of an in-house test program to establish design criteria for crew stations as related to crewmember egress from a single place pilot's station in a weightless environment. The objectives were to investigate the egress problems associated with the panel layout of a minimum volume crew station and to establish optimum location of an overhead hatch for crewmembers wearing regular flight suits during an emergency egress condition. A simulated single place crew station was designed and fabricated in-house and mounted in the Aeronautical Systems Division's zero gravity

aircraft. An overhead hatch bulkhead was designed to be adjustable which allowed the egress task to be performed at different locations from the seat reference point (SRP). Three hatch locations were used. In the first series of tests the hatch opened outward from the crew station and was tested at the three locations; in the second series the hatch was tested at the maximum distance from the SRP but opened inward. Three times were recorded for the egress task; reaction time, egress to the hatch, and egress through the hatch. Three subjects were used to give six replications for each hatch location. The data were statistically analyzed using F ratio and t tests and the results indicated that egress through an inward opening hatch took 1 1/2 to 2 times longer than to egress through the hatch that opened outward. The time required to egress to the hatch proved to be what would be expected; the time increased as the hatch distance to the SRP increased. Author (TAB)

**N66-13990*#** Texas Univ., Austin. Defense Research Lab.
**[STUDIES OF AUDITORY INFORMATION PROCESSING EMPHASIZING THE APPLICATION OF SIGNAL DETECTABILITY THEORY TO THE AUDITORY SENSORY RESPONSES]**
**Fifth Quarterly Progress Report, 1 Jun.–31 Aug. 1965**
L. A. Jeffress 15 Oct. 1965 6 p
(NASA Order R-129; Contract Nonr-3579(04))
(NASA-CR-68881) CFSTI: HC $1.00/MF $0.50 CSCL 05H

The status of work progress in studies of auditory information processing emphasizing the application of signal detectability theory to the auditory sensory responses is reported. A simpler method for averaging receiver operating characteristic data for visual detection, and a method of measuring the galvanic skin response of a subject to various stimuli are described. Other studies mentioned include psychophysical and physiological investigations of brightness. L.S.

**N66-14021#** System Development Corp., Santa Monica, Calif.
**THE DETECTION OF COMPOUND MOTION**
A. S. Cooperband and L. T. Alexander 30 Jul. 1965 13 p refs
Presented at 45th Ann. Western Psychological Assoc. Meeting, Honolulu, Hawaii, 1965
(SP-1946/001/00; AD-622007) CFSTI: HC $1.00/MF $0.50

An analysis of the geometry of the two-target collision prediction situation, and of related research, when taken together suggested that omega, the rate of change of the relative bearing between the two targets, could be a sufficient cue for collision prediction. An abstraction of the geometric situation was used to study the ability of an observer to detect a rotational motion superimposed on a translational motion. The results indicated that omega was used as the cue for detecting this rotational component of motion. Author (TAB)

**N66-14028#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**COSMONAUTS PUT ON THE PRESSURE SUITS**
A. Nikolayev 12 Aug. 1965 7 p Transl. into ENGLISH from Sov. Rossiya (USSR), 19 May 1960
(FTD-TT-65-601/1+4; AD-620788) CFSTI: HC $1.00/MF $0.50

Problems of life support in space are reviewed briefly. The questions of weightlessness, acceleration tolerance, and food, water, and oxygen requirements are considered. TAB

**N66-14151*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
**A WATER-IMMERSION TECHNIQUE FOR THE STUDY OF MOBILITY OF A PRESSURE-SUITED SUBJECT UNDER BALANCED-GRAVITY CONDITIONS**
Otto F. Trout, Jr., Harry L. Loats, Jr., and G. Samuel Mattingly (Environ. Res. Associates) Washington, NASA, Jan. 1966 34 p refs
(NASA-TN-D-3054) CFSTI: HC $2.00/MF $0.50 CSCL 05E

A technique for simulating zero-gravity performance of an astronaut in a pressurized spacesuit by complete water immersion has been developed and investigated. The technique allows the pressure-suited subject to move in six degrees of freedom without the encumbrance of connecting lines or hoses or other supports and further permits performance simulation of long-duration tasks. Experiments were made to demonstrate the relationships between the maneuvers performed by a pressure-suited subject under weightless conditions produced by water-immersion and zero-gravity aircraft flights and those performed under full-gravity conditions. The tests demonstrated that the simulation technique is useful for premission determination of critical operational characteristics relating to spacecraft and spacesuit design under conditions of zero gravity. In addition, the physical capabilities of man and his ability to perform useful work and maneuvers in a pressurized suit under simulated zero-gravity conditions can be demonstrated. Comparison of the subject's motion behavior between the aircraft and water-immersion tests showed that the technique is valid where the velocities are low. Author

**N66-14290*#** Michigan Univ., Ann Arbor. Office of Research Administration.
**[DEVELOPMENT OF ON-LINE MAN–MACHINE SYSTEM PERFORMANCE MEASUREMENT AND DISPLAY TECHNIQUES] Letter Progress Report, Jun. 1–Aug. 31, 1965**
Robert M. Howe and Richard W. Pew 5 Nov. 1965 5 p *Its* Rept.-06343-6-P
(Contract NASr-54(06))
(NASA-CR-68981) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Experimental studies of human performance characteristics in manual control tasks are discussed, and the development of facilities and techniques for systems simulation and human performance data analyses is continuing. Operator performance in three-state relay control systems was investigated, with display blanking methodologies explored. Data analysis confirmed findings of a relationship between the duration of display blanking and the distribution of response times following pulses and blanking. Operator performance with predictable input signals is also discussed, and a parametric sine wave tracking study was initiated. Data analysis and simulation techniques are outlined for power spectral analysis, relay control experiment programming system, predictive display development, and simulation mechanization. M.G.J.

# 06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

**N66-13385** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**OBSERVATION OF ELECTRON PARAMAGNETIC RESONANCE OF THE TRIPLET STATE OF CHLOROPHYLL**
G. T. Rikhireva, Z. P. Gribova et al *In its* Rept. of the Acad. of Sci. of the USSR 3 Aug. 1965 p 7–9 refs (See N66-13383 04-34) CFSTI: HC $1.00/MF $0.50

Electron paramagnetic resonance spectra of the triplet state of chlorophyll were determined for chlorophyll compounds in ethyl alcohol with a high frequency modulated spectrometer. The spectrum of the triplet state of chlorophyll when illuminated with red light at 77° K and the spectrum of a free radical of a pigment in $10^{-3}$ molar solution of chlorophyll under the same conditions are shown. E.E.B.

**N66-13406** Joint Publications Research Service, Washington, D. C.

**ARENE COMPLEXES OF TRANSITION METALS**

Kuo-Yu Hou *In its* Transl. on Communist China's Sci. and Technol., No. 232 3 Nov. 1965 p 1-28 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), No. 7, 14 Jul. 1965 p 35-42 (See N66-13405 04-34) CFSTI: $2.00

A review on arene chromium transition metal $\pi$-complexes and $\sigma$-complexes is presented with emphasis on their application in organic synthesis. The various methods of syntheses for bis-arene chromium $\pi$-complexes are outlined and their comparatively stable properties are discussed. The $\sigma$-complex synthesis was generally more difficult due to a high degree of instability; good yields were only obtained under conditions of low temperature and inert atmosphere. Bis-arene transition chromium $\pi$-complexes can be used as catalysts in polymer synthesis; $\sigma$-ligands coordinated arene transition chromium complexes can be applied in cyclic condensation processes of acetylene, addition reactions to produce naphthalenic and benzene derivatives, and as replacements on coordinated positions through their decomposition into the $\pi$-complexed chromium compounds. G.G.

**N66-13414** Joint Publications Research Service, Washington, D. C.

**HEAT STABLE HETEROCYCLIC POLYMERS**

Meng-Hsien Ting *In its* Transl. on Communist China's Sci. and Technol., No. 235 9 Nov. 1965 p 1-28 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), No. 7, 14 Jul. 1965 p 1-10 (See N66-13413 04-34) CFSTI: $3.00

The syntheses of macromolecules and their formation into heterocyclic polymers of high thermal stability are discussed. A brief review on the various production methods for polyoxazoles, polybenzimidazoles, polyimides, polybenzoxazoles, polybenzothiazoles, and polyquinoxalines is given together with the history of their development and their respective thermal properties. Totally fluorine substituted balanced triazine polymers were obtained by heating fluorine substituted alkylamine; however, the plastic was attacked by alkalics. Polybenzothiazoles, polybenzoxazoles, and polyquinoxalines showed the greatest heat stability. G.G.

**N66-13417** Joint Publications Research Service, Washington, D. C.

**ADHESIVES FROM PHENOL-FORMALDEHYDE-RUBBER**

Ying-Ch'ang Huang *In its* Transl. on Communist China's Sci. and Technol., No. 237 10 Nov. 1965 p 1-30 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), No. 6, 14 Jun. 1965 p 1-9 (See N66-13416 04-34) CFSTI: $2.00

Several methods to obtain combinations of phenol-formaldehyde resins with rubber like bodies were reviewed in order to formulate the basis for a thermal stable adhesive that possesses good impact strength and abrasion resistance. Synchronization of the phenoplast self-condensation rate with the vulcanization rate of the rubber component was found to be of utmost importance. One synchronization method employed a phenoplast prepared from para-alkyl-phenol to slow down the self condensation, and the other used a phenoplast with three active reaction points together with vulcanization accelerators, such as metallic salts, to induce stability. Utilization of an antioxidant to destroy the free radical reaction chain, or of chelating agent to twist the active metal ions into stable positions prevented the adhesive from degradation by aging. Ferrous arsenite was also used to remove active ferrous ions from the adhesive. G.G.

**N66-13418#** Bureau of Mines, Reno, Nev.

**HEAT OF FORMATION OF SCANDIUM TRICHLORIDE**

John M. Stuve 1965 9 p refs

(BM-RI-6705)

Calorimetric data for the dissolution of scandium sesquioxide and scandium trichloride in 4.360 molal hydrochloric acid were used to evaluate the standard heat of formation of $ScCl_3(c)$. The heat of reaction for $Sc(c) + 1.5Cl_2(g) = ScCl_3(c)$ at 298.15° K was computed as $-225,440 \pm 340$ cal/mole.

Author

**N66-13483*#** National Aeronautics and Space Administration, Washington, D. C.

**SYNTHESIS OF ADENYLYL-(5' → N)-AMINO ACIDS (PEPTIDES) BY MEANS OF THE CARBODIIMIDE METHOD [SINTEZ ADENILIL-(5' → N)-AMINOKISLOT (PEPTIDOV) KARBODIIMIDNYM METODOM]**

T. S. Ryabova, Z. A. Shabarova, and M. A. Prokof'yev Dec. 1965 12 p refs Transl. into ENGLISH from Biokhimiya (USSR), v. 30, no. 2, 1965 p 235-240

(NASA-TT-F-9791) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Carbodiimide activation of phosphorus acid residue has been used to synthesize adenylyl-(5'→N)-amino acids (peptides). The method developed makes it possible to obtain nucleotide derivatives of esters of amino acids and peptides both for $\alpha$- and $\epsilon$-amine groups. Conditions of alkaline hydrolysis of the ester bond in the esters of nucleotidyl-(5' → N)-amino acids are described which provide for a good yield of nucleotidylamino acids with a free carboxyl group. UV and IR spectra, electrophoretic mobility, and $R_f$ values in various systems are given for the nucleotidyl-(5' → N)-amino acids (peptides) synthesized. Author

**N66-13497*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

**CROSS-LINKING OF POLYVINYLIDENE FLUORIDE BY GAMMA RADIATION**

George D. Sands and George F. Pezdirtz [1965] 8 p refs Presented at the 150th Natl. Meeting of the Am. Chem. Soc., Atlantic City, 12-17 Sep. 1965

(NASA-TM-X-57037) CFSTI: HC $1.00/MF $0.50 CSCL 07E

Experiments were conducted to determine the effect of high energy ionizing radiation on polyvinylidene fluoride. Tensile strength was found to increase as the polymer was irradiated, which is typical of polymers undergoing cross-linking. Elongation was found to decrease. Solubility was 74% at a dose of 2 MR and fell rapidly to 4% after a dose of 590 MR. This solubility behavior, indicating cross-linking, is consistent with the tensile strength and elongation behavior. As the radiation bonds the polymer chains together into a three-dimensional network, the tensile strength increases because there are more bonds to be broken, but the simultaneous limitation of movement of the chain segments results in a decrease in elongation. The atypical response of polyvinylidene fluoride to radiation, namely cross-linking instead of the expected chain scission, is associated with the small size of the fluorine atom

and as a result the small fluorine groups are not crowded, produce no strain, and hence cross-linking occurs instead of chain rupture. R.N.A.

**N66-13499*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**POLY(IMIDAZOPYRROLONES): A NEW CLASS OF RADIATION RESISTANT POLYMERS**
Vernon L. Bell and George F. Pezdirtz [1965] 11 p refs Presented at the 150th Natl. Meeting of the Am. Chem. Soc., Atlantic City, 12–17 Sep. 1965
(NASA-TM-X-57034) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Experimental procedures are presented for the preparation of polymers, which are called stepladder (partial ladder) and ladder polyimidazopyrrolones or "pyrrones, from the reaction of a dianhydride with a tetraamine in highly-polar solvents such as dimethylformamide, dimethylacetamide, and dimethylsulfoxide. A method is also given for the synthesis of the polymers using the tetrahydrochloride salts of tetraamides. Evidence for the existence of the all-ladder structure of the polymers was deduced from the infrared spectra of thin films. Radiation effect data was obtained on 1 mil films from a PMDA-TADPO polymer. Preliminary results indicate that the imidazopyrrolones appear to be one of the most radiation-resistant polymers to be developed to date. The results of thermal stability studies are also summarized. M.R.W.

**N66-13506#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**HIGH EXPLOSIVES, FUZES, AND FUZING MECHANISMS. PART A. CHEMISTRY OF HIGH EXPLOSIVES: COMPOSITION, USE, SELECTION, MANUFACTURE, AND TESTING OF EXPLOSIVES Surveys of Communist World Scientific and Technical Literature**
25 Aug. 1965 111 p refs
(ATD-P-65-65)

A compilation of abstracts, annotations, and exploitations containing information on the chemistry of explosives is presented. The bibliography is based on Soviet-bloc open source material for the period from 1 January to 31 December 1963 which was available at the Library of Congress. Material reported on includes: synthesis and properties of ammonium nitrate; preparation, properties, testing, classification, and uses of such simple ammonium nitrate explosives as Ammonits, Ammotols, Detonits, Granulits, Igdanits, and Zernogranulits; oxidizing agents; synthesis and properties of Na, K, and Cs ozonides; studies on the sensitivity of explosives; slow decomposition of explosives; explosiveness of gas mixtures; flame extinguishing properties of aqueous gels; ways of lowering the tendency of explosives to burn out; methods of testing; and safety practices. M.R.W.

**N66-13511#** Oak Ridge National Lab., Tenn.
**CRYSTALLINE HYDROXIDES OF THE RARE EARTHS**
R. Fricke and A. Seitz [1947] 11 p refs Transl. into ENGLISH from Z. Anorg. Chem. (Germany), v. 254, 1947 p 107–125
(ORNL-TR-661) CFSTI: HC $1.60/MF $0.80

Crystalline lanthanide trihydroxides can be prepared as hexagonal prisms (at least from La to Er, including Y) by heating the respective hydroxides in concentrated (7*N*) NaOH. Under equivalent conditions of formation, the crystals grow larger progressing to the right along the lanthanide series. The lanthanide hydroxides are soluble in concentrated NaOH, with greater solubility the higher the atomic number of the constituent lanthenide. The decomposition isobars of the trihydroxides indicate them as definite crystalline phases. Positive proof is presented for the existence of an oxyhydroxide phase of composition MeO(OH). The decomposition temperatures of the lanthanide hydroxides decrease with increasing atomic number. Considering its ionic radius, $Y(OH)_3$ has a somewhat lower decomposition temperature than the lanthanide trihydroxides. The existence of a trihydroxide and oxyhydroxide is further confirmed by x-ray studies. The trihydroxides crystallize in the hexagonal system. The values of $c$ and $a$ decrease with increasing lanthanide atomic number, and range from $c = 3.55$ and $a = 6.29$A ($c/a = 0.565$) for $La(OH)_3$ to $c = 3.53$, $a = 6.25$A ($c/a = 0.565$) for $Er(OH)_3$. The number of $Me(OH)_3$ molecules per unit cell is 2.
Author (NSA)

**N66-13561*#** Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
**INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES First Quarterly Report**
P. Ritterman and H. N. Seiger 12 Sep. 1965 54 p refs (Contract NAS3-7620)
(NASA-CR-54832) CFSTI: HC $3.00/MF $0.50 CSCL 07D

X-ray patterns are presented indicating the interference of polyethylene covering. The removal of such a cover yields patterns which are more meaningful, with respect to their relation to stage of charge. Chemical methods have been developed which will make possible the determination of the formula weight of a particular state of charge of the positive electrode. Superior materials, with respect to capacity and charge retention, by formation at 10° C–35 ma and 80° C–100 ma, have been produced. Author

**N66-13568*#** Leesona Corp., Great Neck, N. Y.
**THE IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Quarterly Report No. 1, Jun. 3–Sep. 3, 1965**
J. E. Oxley and C. W. Fleischmann [1965] 21 p refs (Contract NAS5-9591)
(NASA-CR-68646) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The object of this investigation is to gain an understanding of the growth of zinc dendrites during the charging of silver/zinc batteries. It is hoped that from such an understanding it will be possible to suggest a means of overcoming this undesirable feature of secondary batteries employing zinc. Work during the first quarter has emphasized the role of mass transport in governing dendrite morphology and propagation. Further evidence has been gathered for the belief that the mossy type of growth is associated with activation control while the more crystalline dendrite growth corresponds to diffusion control. The role of density gradients caused by depletion of zincate at the electrode surface during deposition was demonstrated. A clear illustration of this was provided by experiments of vertical electrodes where it was seen that propagation of the mossy growth was greatest in the region of highest zinc availability, i.e., at the botton of the electrode. On the other hand, propagation of crystalline dendrites, which is favored by conditions of depletion, was found to be most marked at the top of the electrode. Author

**N66-13576#** International Bio-Research, Inc., St. Louis, Mo.
**SCREENING OF NEW CHELATING AGENTS FOR BERYLLIUM**
Wolfgang Sterner and L. E. Loveless Wright-Patterson AFB, Ohio, Aug. 1965 29 p refs
(Contract (AF 33(615)-1804)
(AMRL-65-135; AD-623321) CFSTI: HC $2.00/MF $0.50

Thirteen polyaminopolycarboxylic acid chelating agents were evaluated in vitro and in vivo as potential therapeutic

agents for acute beryllium poisoning. In the in vitro test system the ability of the chelating agent to reverse beryllium induced inhibition of alkaline phosphate was measured. In the in vivo system, the chelating agent was evaluated by its ability to prevent mortality of rats that had received an acute lethal dose of beryllium sulfate. None of the polyaminopolycarboxylic acids reversed completely the inhibition of alkaline phosphatase at either 35 percent or 65 percent levels of inhibition. All compounds were ineffective in overcoming the toxic dose of beryllium in rats. Author (TAB)

**N66-13590#** Liège Univ. (Belgium). Isotope Lab.
**PREPARATION AND PURIFICATION OF TRITIATED GERANYLLINALOL [PREPARTION ET PURIFICATION DU GERANYLLINALOL TRITIE]**
W. Verly 1965 9 p In FRENCH; ENGLISH summary
(Contract EURATOM-038-62-10 RISB)
(EUR-2531.f) CFSTI: HC $1.00/MF $0.50

Purification of geranyllinalol on silica gel according to Demole, does not seem sufficient to give radiochemical purity when the substance has been tritium labelled by exchange following Wilzbach's method. Acetyl-L-phenylalanyl-L-glutamic acid and its D-L diastereoisomer have quite different partition coefficient between water and butanol : chloroform. Tritiated carnitin and croton-betain, with specific activities of 0.9 mC/mM, have been kept without appreciable radiolysis at −20° C during 12 months. Chemically pure ethyl methanesulfonate has been prepared with 100% yield from ethyl iodide and silver methanesulfonate. Author

**N66-13603#** Rocky Flats Div., Dow Chemical Co., Golden, Colo.
**FORTRAN II DATA REDUCTION PROGRAM FOR GAS PHASE RADIOLYSIS STUDIES**
G. J. Werkema 3 Nov. 1965 26 p
(Contract AT(29-1)-1106)
(RFP-624) CFSTI: $2.00

A computer program is described whose purpose is to convert analytical data obtained at several times during a gas phase radiolysis experiment into the molar and molecular quantities more useful to the chemist. These quantities are presented in tabular form for each gas, along with the computed radiation dose, as a function of time. Author

**N66-13606#** Princeton Univ., N. J.
**PHOTONOMETRIC TITRATIONS Final Report, Sep. 1, 1958–Aug. 31, 1963**
C. G. Enke [1963] 10 p refs
(Contract AF 49(638)-467)
(AFOSR-65-1443; AD-621272) CFSTI: HC $1.00/MF $0.50

The possibility of using light as a quantitative reagent in chemical reactions was investigated. Photolytic reactions with a reproducible quantum yield and whose products are generally useful analytical reagents, e.g., oxidizing or reducing agents, were studied. The photochemical generation of hydrogen peroxide from solutions of various organic acids was investigated for quantitative interest. It was found that dissolved oxygen was a required reactant and determined directly the amount of peroxide formed. Photochemical generation of reactant was used for the photolytic determination of trace amounts of organic material in water. The technique proved to be extremely sensitive. A list of resulting publications is included. Author (TAB)

**N66-13616#** Marquette Univ., Milwaukee, Wis. Dept. of Chemistry.
**ELECTROCHEMICAL STUDIES OF ANTIRADIATION DRUGS. RADIATION EFFECT ON PROTEINS IN THE ABSENCE AND PRESENCE OF THESE DRUGS Final Report**
Walter Stricks 17 Sep. 1965 112 p refs
(Contract DA-49-193-MD-2148)
(Rept.-241; AD-621079) CFSTI: HC $4.00/MF $0.75

The work deals with polarographic and other electrochemical studies of radiation protective agents containing sulfhydryl, disulfide and thiosulfonate groups. These studies were applied to the quantitative determination of sulfhydryl and disulfide compounds by argentimetric and mercurimetric amperometric titration. Using these methods, it is possible to determine the sulfhydryl groups formed in bovine plasma albumin solutions after exposure to ultra violet light. The formation of sulfhydryl groups is explained by the rupture of disulfide during irradiation, one disulfide group giving rise to one sulfhydryl group. Also the polarographic catalytic effect of radiation protective drugs and of plasma albumin solution after irradiation in the absence and presence of these drugs was studied. The splitting of disulfide upon irradiation is accompanied by changes of the viscosity, optical rotation and light absorption in the ultraviolet region. The relationship between changes of these properties and the number of broken disulfide groups was demonstrated. Author (TAB)

**N66-13619#** Manchester Coll. of Science and Technology (England). Dept. of Chemistry.
**INHIBITION OF THE THERMAL REACTION BETWEEN HYDROGEN AND OXYGEN Final Scientific Report**
D. R. Blackmore, D. R. Clark, and R. F. Simmons 1 Mar. 1965 30 p refs
(Grant AF-EOAR-62-88)
(AFOSR-65-1239; AD-621216) CFSTI: HC $2.00/MF $0.50

The kinetics of the inhibiting action of hydrogen bromide and hydrogen chloride on the thermal reaction between hydrogen and oxygen was investigated. Hydrogen bromide was found to be a very effective inhibitor of the reaction, while hydrogen chloride was relatively inefficient. The kinetic characteristics of the inhibition were examined, and it was shown that in the case of hydrogen bromide the primary inhibition step is: $H + HBr$ yields $H_2 + Br$. Only a fraction of the bromine atoms produced in this reaction react to given chain termination, however, and the majority react to give chain propagation by: $Br + H_2$ yields $HBr + H$. It is suggested that chain termination occurs by: $Br + HO_2$ yields $HBr + O_2$. The corresponding mechanism is also operative when hydrogen chloride is the inhibitor, but a second primary inhibition step is also important in this case: $OH + HCl$ yields $H_2O + Cl$. The reason for the marked difference in efficiency of hydrogen bromide and hydrogen chloride is discussed. Author (TAB)

**N66-13628#** Argonne National Lab., Ill.
**A THERMODYNAMIC STUDY OF THE URANIA–URANIUM SYSTEM**
R. J. Ackermann, E. G. Rauh, and M. S. Chandrasekharaiah Jul. 1965 35 p refs
(Contract W-31-109-ENG-38)
(ANL-7048) CFSTI: $2.00

The phase diagram (temperature-pressure-composition) for the uranium–oxygen system from 1600° to 2500° K for the composition range of the bivariant urania phase was investigated. The composition of the urania phase in equilibrium

with liquid uranium was determined by an isopiestic method. This phase dissolves uranium up to a composition given by the ratio O/U = 1.82 at 2500° K. The total volatility rates for urania–liquid uranium mixtures were measured by means of the effusion method from 1580° to 2400° K. Mass spectrometric measurements were made and combined with the total effusion rates to yield partial pressures for each species. The thermodynamic analysis of the urania–uranium system includes: (1) calculations of the partial pressures in equilibrium with urania–liquid uranium; (2) the standard free energy of formation of gaseous uranium monoxide; (3) the partial pressure of oxygen in equilibrium with urania–liquid uranium; and (4) the evaporation behavior of the urania phase. R.R.D.

**N66-13662#** Atomic Energy Commission, Washington, D. C.
**POLARIZATION DURING ION REDOX PROCESSES. RECHARGINGS. IONS OF IRON, THALLIUM, CERIUM AND VANADIUM**
L. Antropov and E. Mizgireva [1965] 23 p Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), no. 15, 1941 p 776–792 (AEC-TR-6572) CFSTI: HC $1.00/MF $0.50

The possible operation of ion oxidation-reduction process was analyzed and the possible reasons for redox-polarization were explained. It was established that chemical polarization can be explained by slow discharge or slow desorption. Based on the assumption that redox-polarization depends on secondary ion accumulation occurring on the surface of the electrode, an equation was derived for slow desorption. The validity of the derived equation is quantitatively confirmed by the example of the discharged ions of the rare elements—thallium, cerium, vanadium, and iron. In line with the hypothesis of slow desorption requirements, the absolute value of polarization and the nature of its change with respect to current intensity, are determined by the nature of the primary and secondary ions. The maximum polarization, which changes most during the increase of current intensity, should be observed and actually is observed for the ion systems of the 11б type, the minimum and slightly changing polarization during the current increase, is observed for the systems of the IIa type; for the Ia and I6 system it is not very high. The viewpoint developed here makes it possible to predict the more probable type of polarization for the given redox system provided the nature of its primary and secondary ions is known. Scrutiny of Ferster's data on recharge of $V^{V} \rightarrow V^{IV}$ and $V^{III} \rightarrow V^{II}$ and also $Mo^{VI} \rightarrow Mo^{V}$ shows that the relations found with it are well described by the equation for polarization associated with slow desorption. Author (NSA)

**N66-13665#** Utah Univ., Salt Lake City. Dept. of Chemistry.
**RESOLUTION IN CHROMATOGRAPHY Final Report, 1 Apr. 1959–31 Mar. 1965**
J. Calvin Giddings [1965] 15 p refs
(Contract AT(11-1)-748)
(COO-748-1) CFSTI: HC $1.00/MF $0.50

Research was conducted on: basic chromatographic processes, optimum parameters in chromatography, effects of temperature and temperature programming, and preparative scale operation. Results obtained in each area are described. NSA

**N66-13667#** California Univ., Livermore. Lawrence Radiation Lab.
**ROLE OF OXYGEN IN SOLID-SOLID REACTIONS**
J. Birch Holt 23 Jul. 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-12396; Conf-650644-1) CFSTI: HC $1.00/MF $0.50

An understanding of the mechanism of spinel formation from solid-solid reactions remains incomplete, mainly because of the lack of data on the role of oxygen in the over-all reaction. Oxygen diffusion along grain boundaries, through pores, in the gas phase or through the lattice has been postulated. To clarify the part oxygen plays in these reactions, the formation of $CoAl_2O_4$ from CoO and $Al_2O_3$ was studied using single and polycrystalline samples in which oxygen-18 was incorporated. The heat treatments were carried out in various atmospheres. The oxygen mobility was followed by activation of the oxygen-18 by proton bombardment to yield the radioisotope, fluorine-18. The oxygen distribution in the product phase is indicated by autoradiography. It was found that CoO and $Al_2O_3$ react to form the spinel by the Wagner mechanism. Author (NSA)

**N66-13688#** Brussels Univ. (Belgium).
**MASS SPECTROMETRIC STUDY OF THE OXIDATION OF TUNGSTEN AND TANTALUM**
J. Drowart, F. Degreve, D. Detry, and S. Smoes Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1965 14 p refs (Contract AF 61(052)-700)
(AFML-TR-65-145; AD-622809) CFSTI: HC $1.00/MF $0.50

The rates of oxidation of tungsten and tantalum were studied in the respective temperature intervals 1450–2500 and 1900–2900° K at oxygen pressures between $8 \times 10^{-8}$ and $7 \times 10^{-5}$ Torr. The apparent partial pressures of the gaseous oxides formed, $WO_2$, $WO_3$, TaO and $TaO_2$ were determined. The rate of oxidation of tantalum is strongly time dependent. At the maximum, the amounts of oxides produced represent for W and Ta, respectively, about 1/92 and 1/16 of the incident molecular oxygen. Author (TAB)

**N66-13693#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
**BASIC ATOM CHEMISTRY: SURFACE CATALYZED EXCITATION Final Report, Sep. 1962–Aug. 1964**
Paul Harteck Jun. 1965 8 p refs
(Grant AF-AFOSR-174-63)
(AFOSR-65-1273; AD-622583) CFSTI: HC $1.00/MF $0.50

An investigation was made concerning the production of excited molecules on the surface of a catalyst by recombination of atoms. It was found that catalysts such as nickel and cobalt are effective in producing excited molecules from oxygen and/or nitrogen atoms. In addition even conditioned glass or quartz surfaces frequently and unexpectedly catalyze the formation of excited molecules. Catalyzed excitation of this type was observed when oxygen atoms were present in the gas phase at a total pressure ranging from a few microns to one millimeter. In all atom studies involving reaction kinetics or spectroscopic observations at low pressures, it would appear necessary that caution be taken to assure that the role of surface catalyst is understood for the particular case consideration. TAB

**N66-13710#** Atomic Weapons Research Establishment, Aldermaston (England).
**A HELIUM GAS CHROMATOGRAPHY APPARATUS WITH HIGH VACUUM SAMPLING SYSTEM**
J. R. Nash and T. Sargent London, HMSO, Jun. 1965 21 p ref (AWRE-O-22/65) HMSO: 4s

A helium gas chromatography apparatus for sampling small (0.1 cc) amounts of gas such as are extracted from metals is described. An ionization detector is used whose

sensitivity can be adjusted to suit the composition of the gas. Very small aliquots of sample can be tested by the system described. Analyses of gas from blisters in fuel plates and gas extracted from zirconium hydride are given. Author

**N66-13716#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CHEMISTRY AND TECHNOLOGY OF FUELS AND LUBRICANTS Selected Articles**
15 Sep. 1965 22 p refs Transl. into ENGLISH from Khim. i Tekhol. Topliv i Masel (Moscow), no. 8, 19
(FTD-TT-65-704/1+2; AD-621797) CFSTI: HC $1.00/MF $0.50

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**N66-13717** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ACTION OF ADDITIVES ON WEAR-RESISTANCE ANTI-FRICTION PROPERTIES OF POLYSILOXANE**
M. I. Nosov and G. V. Vinogradov *In its* Chem. and Tech. of Fuels and Lubricants 15 Sep. 1965 p 1–9 refs (See N66-13716 04-06) CFSTI: HC $1.00/MF $0.50

Experiments were performed to determine the specific action of additives during boundary friction. Polyethylsiloxane fluid (PES) and two polymethylphenylsiloxane fluids with low (polymer 3) and high (polymer 2) content of phenyl groups were used; their properties are tabulated. The relationship between additive activity and the nature of polysiloxane, and the action of molecular oxygen on additive properties were also considered. Results indicate: (1) Additives distinguished by high activity in relation to preventing jamming of steel in hydrocarbon lubricants act very weakly in polysiloxane. (2) Polymethylphenylsiloxane is more sensitive to wear-resistant and antiscore additive action. The additives affect the character of mechanical relaxation variations, average value of kinetic friction, and residual friction when the moving surfaces are stopped. (3) Tests in open air and under a vacuum of sulpho-, chlorine-, and phosphor-organic compounds in polyethylsiloxane show that molecular oxygen affects additive efficiency. M.G.J.

**N66-13718** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DETERMINATION OF ANTIOXIDANT ADDITIVES IN OILS BY THE THIN-LAYER CHROMATOGRAPHIC METHODS**
N. D. Zubkova, Yu. I. Turskii, V. I. Genkina, and G. V. Klyuchko *In its* Chem. and Tech. of Fuels and Lubricants 15 Sep. 1965 p 11–19 refs (See N66-13716 04-06) CFSTI: HC $1.00/MF $0.50

For qualitative analysis of additives in lubricating oils, the possibility of using thin-film chromatography on a nonfixed layer of aluminum oxide was examined. Details are given on the chromatographic analysis of alkly-phenols and aryl-amines, and the application of this method for identifying antioxidant additives in oils is described. Mineral oil, and synthetic oil on a dioctyl-sembacinate base were investigated, and results indicate that amine compounds are present in the synthetic oil. The data were experimentally confirmed by separating the detected antioxidant additives from the analysed oils, recrystallizing them from the solvents for purification, and identifying them. It was concluded that the method has the advantages of simplicity, high sensitivity, and speed (about 15 to 20 minutes); and permits detection of an antioxidant additive in oil at a minimum concentration of 0.05%. M.G.J.

**N66-13724#** Cornell Univ., Ithaca, N. Y.
**I: THE MECHANISMS OF A DIELS-ALDER REACTION. II: THE MECHANISMS OF PERESTER AND DIACYL PEROXIDE CLEAVAGE. III: THERMAL TELOMERIZATION OF DIMETHYL ACETYLENE-DICARBOXYLATE Final Report**
M. J. Goldstein, G. L. Thayer, Jr., and M. Yoshioa Aug. 1965 26 p refs
(Grant AF-AFOSR-142-63)
(AFOSR-65-142-63; AD-621526) CFSTI: HC $2.00/MF $0.50

The thermal expulsion of $CO_2$ from the maleic anhydride adduct of alpha-pyrone and the isolation of a crystalline material from the thermal reaction at 150° C of alpha-pyrone in dimethyl acetylenedicarboxylate are discussed. Also, the characterization and reaction products of tert-butyl peracetate, perbenzoate, perpivalates, and acetyl peroxide are reported. The thermal telomer of dimethyl acetylenedicarboxylate was also prepared. E.E.B.

**N66-13746#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**STUDYING THE PROCESS OF TITANIUM CARBIDE FORMATION PRECIPITATED FROM GASEOUS PHASE**
V. P. Yelyutin, G. I. Pepekin, and B. S. Lysov 15 Sep. 1965 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 3, 1964 p 124–130
(FTD-TT-65-738/1+2+4; AD-621737) CFSTI: HC $1.00/MF $0.50

The method of accrediting high melting carbides from gaseous phase consists in reducing the volatile halide compound of the metal into carbide with a hydrogen and hydrocarbon mixture on a preheated surface. The process is realized in a hydrogen stream at atmospheric pressure. In case the precipitation process is carried out on a graphite surface the hydrocarbon vapors may be absent in the initial mixture. TAB

**N66-13753#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF OBTAINING COMBINED MIXTURES OF POLYAMIDE AND POLYFORMALDEHYDE**
B. A. Yegorov, A. V. Yudin, and V. M. Barboy 21 Sep. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 166829 (Appl. No. 825008/23-5, 14 Mar. 1963) 1 p
(FTD-TT-65-524/1+4; AD-622344) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method for obtaining combined mixtures of polyamide with polyformaldehyde which has the distinguishing feature that, for the purpose of obtaining uniform mixtures, the polyformaldehyde is dissolved in the monomer of polyamide and then the polymer is subjected to polymerization. Author (TAB)

**N66-13754#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF STABILIZING SILICONE OILS**
G. S. Tubyanskaya and R. I. Kobzova 21 Sep. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 162268 (Appl. No. 856107/23-4, 9 Sep. 1963) 1 p
(FTD-TT-65-520/1+4; AD-622349) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of stabilization of silicone oils by means of the introduction of additives which has the distinguishing feature that, as an additive, cyclopentadienyl tricarbonyl manganese is introduced. Author (TAB)

**N66-13800#** Monsanto Research Corp., Everett, Mass. Boston Lab.
**CHEMILUMINESCENT SYSTEMS Technical Report No. 5**
A. W. Berger and J. A. Pirog 30 Sep. 1965 54 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB300Q5; AD-622503) CFSTI: HC $3.00/MF $0.50

Maximum brightness and efficiency of the chemiluminescent autoxidation of indoles in basic solution in polar aprotic solvents is found for the 5- and 6-substituted skatoles. 2,3-Dimethylindole-5-carboxylic acid yields greater peak brightness than skatole at the standard 0.005 M concentration in DMSO, although with lower efficiency than skatole. The fluorescence spectrum of a basic solution of orthoacetamido acetophenone, in DMSO, matches the chemiluminescence emission spectrum of 2,3-dimethylindole in peak wavelength and contour. Author (TAB)

**N66-13824#** Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
**MOLECULAR STRUCTURE AND SPECTRA Quarterly Status Report, 1 Jan.–31 Mar. 1965**
[1965] 9 p
(Contract Nonr-2121(01))
(QSR-33; AD-620903) CFSTI: HC $1.00/MF $0.50

Theoretical and experimental work in the field of molecular structure and spectra is summarized with the general purpose of obtaining a better and more quantitative understanding of the spectra and energy levels of molecules and of the foundations of structural chemistry. TAB

**N66-13863#** Junta de Energia Nuclear, Madrid (Spain). Division de Quimica
**DETERMINATION OF PALLADIUM BY FLAME PHOTOMETRY [DETERMINACION DE PALADIO POR FOTOMETRIA DE LLAMA]**
A. Parellada Bellod 1964 14 p refs In SPANISH
(JEN-148-DQ/I-49) CFSTI: HC $1.00/MF $0.50

A study on the determination of palladium by flame photometry, fixing the most convenient experimental conditions and using organic solvents to increase the emission of this element, is carried out. Among the organic solvents, acetone was found the most efficient. The interferences produced by anions and cations were also studied and an analytical method is related, in which lines of calibration for 0 to 100 ppm of palladium are used. Author (NSA)

**N66-13866#** Atomic Energy Commission, Washington, D. C.
**FLOW METHOD OF IRRADIATION WITH IONIZING RAYS**
A. V. Zimin and F. Y. Frolov [1965] 9 p Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Fiz.-Khim. (USSR), no. 3, 1963 p 130–133
(AEC-TR-6567) CFSTI: HC $1.00/MF $0.50

A unit for the irradiation of a material in flow comprises an evaporator, condenser, irradiation container, and a flow-measuring device. In the irradiation process, the condensed vapors are allowed to fall from the condenser into the irradiation container and thence into the evaporator. Calculations of the maximum allowable concentration of radiolysis product in the irradiation zone are made for the following radiolyses: $2H_2O \rightarrow H_2O_2$, $2CCl_4 \rightarrow C_2Cl_6 + Cl_2$, $C_6H_6 + CCl_4 \rightarrow C_6H_5CCl_3 + HCl$, and $C_6H_6 + C_2F_3Cl_3 \rightarrow C_6H_5C_2F_3Cl_2 + HCl$. Another unit using a bellows compressor is also described. Author (NSA)

**N66-13884#** Oak Ridge National Lab., Tenn.
**ZONE MELTING OF INORGANIC FLUORIDES**
A. J. Singh (Atomic Energy Estab. Bombay), R. G. Ross, and R. E. Thoma Jul. 1965 28 p refs
(Contract W-7405-ENG-26)
(ORNL-3658) CFSTI: HC $3.00/MF $0.50

The segregation behavior of NaF, $CaF_2$, $MgF_2$, and $MnF_2$, commonly present as impurities in LiF, was investigated using zone melting techniques as a possible means of obtaining higher purity LiF for use in growing large single crystals. Experimental values obtained for the distribution coefficients of the ions, $Na^+$, $Ca^{2+}$, $Mg^{2+}$, and $Mn^{2+}$ in LiF are $Na^+$, 0.1; $Ca^{2+}$, 0.1; $Mg^{2+}$, 0.7 to 0.8, and $Mn^{2+}$, 0.2 to 0.3. Zone melting techniques were also employed to study crystallization behavior of the fluoride salt mixture $LiF–BeF_2–ZrF_4–UF_4$ (66–28–5–1 mole %). Segregation of the uranium-bearing phase was found to be enhanced by vertical zone melting with downward passage of the molten zone, while the homogeneity of the mixture was not affected by upward passage of the zone. Author (NSA)

**N66-13890#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ESTERS ON MONOARYLIDES OF PHENYLPHOSPHINIC**
I. N. Zhmurova 6 Apr. 1965 9 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 33, no. 2, 1963 p 549–551
(FTD-MT-63-235; AD-619566) CFSTI: HC $1.00/MF $0.50

It was found that esters of monoarylides of phenylphosphinic acids are formed during the action of alkanols and phenols on acid chlorides of monoarylides of phenylphosphinic acids. TAB

**N66-13893#** Oregon State Univ., Corvallis. Dept. of Chemistry.
**THE LEWIS ACIDITY OF DIBORON TETRAFLUORIDE**
John D. Hansen and Theran D. Parsons 16 Aug. 1965 8 p refs
(Contract Nonr-1286(04))
(TR-5; AD-620327) CFSTI: HC $1.00/MF $0.50

The stability of Lewis acid-base adducts of diboron tetrafluoride, boron trifluoride, and boron trichloride with various bases, and acid displacement reactions of the complexes are reported. It has been confirmed that boron trichloride is a stronger Lewis acid than boron trifluoride toward representative bases with both oxygen and nitrogen donor atoms. It has been established that diboron tetrafluoride is a weaker Lewis acid than boron trifluoride. Possible reasons for this difference are discussed. Good methods for the purification of boron trifluoride and boron trichloride are presented. Author (TAB)

**N66-13925#** Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
**OF FLOATING-ZONE URANIUM [SUR L'URANIUM DE ZONE FLOTTANTE]**
George Clottes (Ph.D. Thesis—Paris Univ.) 1965 113 p refs In FRENCH
(CEA-R-2767) CFSTI: HC $4.00/MF $0.75

The floating zone method was chosen in order to purify uranium. The various parameters of this method were studied theoretically and technologically. The most efficient speed is 0.7 cm/hr, the direction can be only upwards, and the fusion must take place under pressure of $10^{-7}$ torr or so. The study of the floating zone stability led to a definition of a field touching the size and diameter of uranium drops, which, on the one hand coincides with Heywang's conditions and, on the other hand, is compatible with a fusion in the core of the bar. Such field shows that the floating zone can easily apply to bars whose diameter is included between 5 and 10 mm, and that it

cannot work out when the diameter exceeds 21 mm. The apparatus, with a means of heating by electronic bombardment under ultra-vacuum, is conditioned by the various parameters that have been studied. As the analysis results were insufficient, the uranium was characterized by metallurgical and physical tests: micrographical tests, microhardness, and electric resistivity at low temperature, showed a definite purification at the bar head; these results were confirmed by the lowering at 270° C of the recrystallization temperature together with the definite tendency of the refined metal to polygonize. The electric resistivity measurements constitute an easy and quantitative way of figuring out the metal purity. The influence of an impurity on the electric resistivity of uranium was studied with U–Au alloys with a weak concentration of gold. Two important points were brought out: (1) The measurement of electric resistivity should be performed on bars annealed in $\gamma$ phase and cooled. (2) Gold has a very strong influence on uranium; the value 500 $\mu\Omega$cm·percent of gold resulted in a total concentration of 20 to 30 ppm of soluble impurities in the refined metal. NSA

**N66-13938#** Johannes-Gutenberg-Universitat, Mainz (West Germany).

**REACTIONS OF FISSION RECOIL ATOMS, PARTICULARLY OF IODINE WITH METHANE AND OTHER GASES [REAKTIONEN VON SPALTRUCKSTOSSATOMEN, INSBESONDERE VON JOD, MIT METHAN UND ANDEREN GASEN]**

Johannes-Otto Denschlag (Ph.D. Thesis) 1965 199 p refs In GERMAN

(NP-15370) CFSTI: HC $5.00/MF $1.25

It was shown that in the interaction of fission recoil nuclei with methane, methyl iodide and methyl bromide are formed. In the reaction on ethane, methyl iodide, methyl bromide, ethyl iodide, and vinyl iodide could be detected. In each case, methyl iodide is the principal reaction product (>60%). The compounds are liquid at room temperature and remain for a long time (at least hours) in the gas space. Elementary iodine and hydrogen iodide also appear to be produced, but they are precipitated within seconds on the vessel walls. Therefore, within minutes after irradiation, only organically bound iodine could be detected. Three reaction processes to the methyl iodide could be identified: (1) a prompt reaction of the fission recoil nuclei of the primary iodine; (2) a prompt reaction of the $\beta$-recoil atoms of the secondary iodine; and (3) a delayed reaction of the iodine, that reacted according to neither (1) nor (2) and was fixed on the vessel walls. It can be described as a first-order reaction and was characterized by a half life. The yields on methyl iodide fluctuate greatly. For reaction (1) a yield of 66% of the primary iodine was found for the most favorable case. A yield of only 3 to 4% also was detected. The yield for reaction (2) was only a tenth of the yields of reaction (1) (0 to 2.5%). The half life of reaction (3) was more than 140 days, and this reaction plays no role in short irradiations. The three reactions are not temperature dependent in the range from 20 to 80° C. In a reaction after the end of the irradiation, it was established that the reaction (3) was amplified by $\gamma$ radiation. Because of the stronger reaction of the primary iodine, the fractional primary yields of the measured iodine isotope were calculated at <3% for $^{131}$I, 4.6 ±2% for $^{133}$I, and 25 ±1% for $^{135}$I. They are approximately in agreement with the values expected from the systematics of the independent yield: 0.2, 4, and 37% of the chain yield. Only the $^{135}$I value deviates noticeably. The calculation of the primary iodine yield and the reaction yields (or the half life of reaction (3)) was done by an iteration method, that is programmed in "Algol." Author (NSA)

**N66-13940#** Library of Congress, Washington, D. C. Aerospace Technology Div.

**STRUCTURE OF ORGANIC CRYSTALS Surveys of Soviet Scientific and Technical Literature—Bibliography**

John Kourilo 4 Dec. 1965 40 p refs

(ATD-65-77)

The data presented are based on the Soviet open source materials. One hundred and nine entries are divided into thirteen sections corresponding to subdivisions of organic chemistry on the basis of functional groups. Entries pertaining to the study of unspecified polymers or polymers containing several functional groups are included. The entries under the subject heading electron diffraction, include electron microscope studies. R.W.H.

**N66-13948#** Temple Univ., Philadelphia, Pa. Research Inst.

**HIGH-TEMPERATURE INORGANIC CHEMISTRY Seventh Annual Progress Report**

A. V. Grosse and J. A. Cahill 30 Aug. 1965 55 p refs (Contract AT(30-1)-2082)

(TID-22144) CFSTI: HC $3.00/MF $0.50

The relationships between the electric conductivities, thermal conductivities, and temperature of liquid metals over their entire liquid range are discussed, and some results are given for Hg and the alkali metals. The work on the correlation of densities, volumes, expansion coefficients, and atomic cell dimensions of Hg from 0 to 1733° K is reported on briefly. Some results are reported for the kinematic viscosities of Hg, Na, and K over their liquid range. Preliminary electric resistivity measurements were made on liquid Sn up to 2000° K. Viscosity studies are described, and results are given for liquid Sn and Ag. The surface tension of liquid salts near the critical temperature is discussed briefly. Data are presented on the solubility of C in liquid Zr to 4000° K. The behaviour of a liquid ZrC–C solution on liquid $W_2C$ at 3250° K in a graphite crucible was studied. NSA

**N66-13960#** Sandia Corp., Albuquerque, N. Mex.

**ABSORPTIVITIES OF COMPLEXES FROM THE VARIATION AND THE MOLE RATIO METHODS FOR COMPLEX DETERMINATIONS**

James O. Wear Nov. 1965 18 p refs Supported by AEC

(SC-RR-65-625) CFSTI: $1.00

This study shows that the absorptivities of complexes can be determined from the slopes of the lines in the standard plots of the variational and the mole ratio methods for complex determination. The mathematics of the mole ratio method have been developed and are presented here. The variational method was used to determine the complexes of phenolphthalein with Np(VI). Two complexes,

$$(NpO_2)_3Y^{n} \text{ and } (NpO_2)_4Y^{m},$$

where $n$ and $m$ are the charges and Y is phenolphthalein or some ionic form of it. The absorptivities of the different complexes at various wavelengths were determined by using the techniques developed here. The mole ratio method was used to determine two complexes of Np(V) with oxalate ion,

$$(NpO_2)_2C_2O_4 \text{ and } NpO_2(C_2O_4)_3^{5-}.$$

The absorptivities of these complexes were also determined by using techniques developed for this purpose. Author

**N66-13974#** Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering.
**THE STRUCTURE AND PROPERTIES OF ORIENTED COMPOUND EUTECTICS**
John William Moore (Ph.D. Thesis) Aug. 1965 169 p refs
(Contract Nonr-1224(47))
(Rept.-05612-3-T; AD-623528) CFSTI: HC $5.00/MF $1.00

The study involved (1) the preparation of unidirectionally solidified eutectic ingots of MnO-MnS, FeO-FeS, NaCl-NaF, NaBr-NaF and LiF-NaF, (2) the determination of the crystallographic orientation of each phase with respect to the direction of solidification and the planar interface between the phases, (3) the measurement of the thermal expansion of the MnO-MnS eutectic and the MnS phase, (4) the determination of the slip modes, fracture characteristics and directional indentation hardness of the MnO-MnS eutectic and the MnO phase, and (5) the comparison of the measured properties of the lamellar MnO-MnS eutectic with those of the MnO and MnS phases. TAB

**N66-13991*#** Tyco Labs., Inc., Waltham, Mass.
**DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE $H_2/O_2$ FUEL CELLS WITH AN ALKALINE ELECTROLYTE First Quarterly Report, Jul. 1–Sep. 30, 1965**
A. C. Makrides, R. J. Jasinski, and J. Giner [1965] 59 p
(Contract NASw-1233)
(NASA-CR-68891) CFSTI: HC $3.00/MF $0.50 CSCL 07D

Various metallic ingots were prepared and tested for corrosion resistance and electrocatalytic activity in a rotating electrochemical cell, the temperature of which can be regulated. The solid ingots were mounted in an alkali resistant resin and tested potentiostatically as a rotating disc electrode run consecutively in $N_2$- and $O_2$-saturated KOH solution. The method of preparing the solid ingots as rotating disc electrodes is described, and schematic diagrams of a rotating disc electrode, a rotating electrode cell, and a floating electrode cell are shown. Current potential curves for Pt, Au, Ag, Ta, $Zr_2Ni$, TiNi, NbPt, TiCu, $TaPt_2$, $TiPt_3$, $TaPt_3$, $TiCu_3$, $ZrAu_3$, $NbNi_3$, $TiNi_3$, $TiCr_4$, WC, $Cr_3C_2$, TiC, and $Ni_3B$ are given. LS

**N66-13999#** Argonne National Lab., Ill.
**PICTORIAL STUDIES OF MOLECULES. I: MOLECULAR ORBITAL DENSITY COMPARISONS OF $H_2$, $Li_2$, $B_2$, $C_2$, $N_2$, $O_2$, AND $F_2$**
Arnold C. Wahl Jul. 1965 58 p refs
(Contract W-31-109-ENG-38)
(ANL-7076) CFSTI: $3.00

Contour diagrams of the molecular orbital and total electron densities of the homonuclear diatomic molecules $H_2$, $Li_2$, $B_2$, $C_2$, $N_2$, $O_2$, and $F_2$ are presented on a consistent basis convenient for comparison. These diagrams are calculated and drawn automatically by programs written by the author for the CDC-3600 computer. The molecular orbitals used in this study are the result of recent self-consistent field calculations and are thought to be very near the Hartree-Fock orbitals. The importance of such visual presentations is stressed, and further use in studies of chemical bond formation and molecular ionization indicated. Author

**N66-14004#** Naval Radiological Defense Lab., San Francisco, Calif.
**THE RADIATION-INDUCED DECOMPOSITION OF MILLIMOLAR CONCENTRATIONS OF HYDROGEN PEROXIDE IN AERATED "PURE WATER"**
William R. Balkwell and Susan B. Oldham 19 Aug. 1965 20 p refs
(USNRDL-TR-903; AD-623095) CFSTI: HC $1.00/MF $0.50

The decomposition of hydrogen peroxide in aerated 'pure water' was studied as a function of dose and initial hydrogen peroxide concentration, $(H_2O_2)0$, in the 1 to 100 millimolar concentration region. Irradiations were performed with a 2000-curie $Co_{60}$ source at a dose rate of 12.8 kilorads per minute. The decomposition of hydrogen peroxide was found to follow first order kinetics with respect to peroxide in the 1 to 100 millimolar concentration range. The specific peroxide decomposition rate constant was observed to decrease with an increase in initial peroxide concentration. The decomposition yield of hydrogen peroxide, $G\text{-}(H_2O_2)$, at a given dose was found to increase significantly with increasing initial peroxide concentration and to be proportional to the square root of the initial peroxide concentration up to about 40 millimolar peroxide. The peroxide decomposition yield for a given initial peroxide concentration was observed to decrease continually during irradiation. The rate of decrease was found to be greater for higher initial concentrations of peroxide. Author (TAB)

**N66-14006#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**OSCILLATORY SPECTRUM OF COMBINED DIFFUSION OF GASEOUS $NF_3$**
Yu. I. Kotov and V. M. Tatevskiy 22 Sep. 1965 5 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), no. 2, 1963 p 305–306
(FTD-TT-65-781/1+2+4; AD-622343) CFSTI: HC $1.00/MF $0.50

Investigation of the spectrum of combined diffusion of gaseous $NF_3$ was conducted with the aid of a multipasstype vessel. Two of the bands are wide ones: $\nu_4$ = 495/cm and $\nu_3$ = 911/cm, confirming their designation to degenerated (incompletely symmetrical) oscillations of the $NF_3$ molecule. Two other bands ($\nu_1$ = 1033/cm and $\nu_2$ = 646/cm) appear to be sharp ones and belong to fully symmetrical oscillations of the $NF_3$ molecule. The frequency values observed are in good agreement with values found earlier from infrared absorption spectra (M.K. Wilson and S. R. Polo, J. Chen. Phys. 20:1716 (1952) and E. L. Pace and L. Pierce, J. Chene. Phys. 23:1248 (1955)). TAB

**N66-14013#** University of Southern Calif., Los Angeles. Dept. of Chemistry.
**SULFENIC ACIDS AND THEIR DERIVATIVES. XLI: SULFENYL NITRATES AND SULFINYL RADICALS**
Richard M. Topping and Norman Kharasch [1959] 6 p refs
(Contract AF 49(638)-718)
(AFOSR-267; AD-621222) CFSTI: HC $1.00/MF $0.50

Sulfenyl nitrates, $RSONO_2$, represent a novel class of sulfenyl compounds. The preparation of the first examples is described and some of their properties are recorded. The near-quantitative conversion of sulfenyl nitrates to thiolsulfonate esters (2 $RSONO_2$ yields $RSO_2SR + 2NO_2$) is demonstrated and interpreted as a dimerization reaction of sulfinyl radicals. Author (TAB)

**N66-14019#** Applied Physics Labs., Johns Hopkins Univ., Silver Spring, Md.
**FABRICATION AND EVALUATION OF SILICON EPITAXIAL FILMS MADE BY THE PYROLYTIC DECOMPOSITION OF SILICON TETRACHLORIDE Technical Memorandum, Sep. 1965**

M. F. Goodman Sep. 1965 40 p refs
(Contract NOw-62-0604-c)
(TG-731; AD-622287) CFSTI: HC $2.00/MF $0.50

EPITAXIAL FILM FABRICATION: The following items are discussed: gas bubbler for the saturator that insures saturation of the hydrogen carrier gas with $SiCl_4$, reaction chamber that can withstand the 1000 to 1300C deposition temperature and will not appreciably dope the substrate material, a susceptor material that allows efficient RF coupling and negligible background doping, requirements for the carrier gas, and flow meters and valves that can handle the gases used. GROWING DOPED SILICON EPITAXIAL FILMS BY PYROLYTIC DECOMPOSITION: Preparation of the Si substrate includes chemical etching by hydrogen chloride gas. Step-by-step directions are given for preparation of the system. IMPORTANT FILM GROWTH PARAMETERS: Growth rate of the film is held constant with time by having fixed temperatures for the furnace and evaporator and fixed gas flow rates. TECHNIQUES USED IN FILM EVALUATION. TAB

N66-14022# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
A GENERAL STUDY OF THE PROPERTIES OF SILYL RADICALS Final Report
Grant Urry 10 Jun. 1965 80 p refs
(Grant AF-AFOSR-225-63)
(AFOSR-65-1442; AD-621131) CFSTI: HC $3.00/MF $0.75

The following papers, plus a list of personnel and publications, comprise the report: Some stable monoboron free radicals-2,2'-bipyridine stabilization of unusual oxidation states of boron, by Mark A. Kuck and Grant Urry; Mercury arc induced condensations of methylchlorosilanes, by John Elbert Hanson and Grant Urry; The preparation and properties of bis (8-quindichlorosilicon IV, by M. M. Millard and Grant Urry; Probing with ESR, (reprinted from Horizon, vol. 11, no. 1, p. 3–4, 1964); Chelation may stabilize boron compounds (reprinted from Chemical and Engineering News, 12 Apr. 1965, p. 48). TAB

N66-14027# Naval Ordnance Lab., Corona, Calif.
FOUNDATIONAL RESEARCH PROJECTS Quarterly Report, Apr.–Jun. 1965
1 Sep. 1965 24 p refs
(NAVWEPS-8819; AD-620865) CFSTI: HC $2.00/MF $0.50

Three papers are presented: (1) A method of Measuring Dielectric Constants at Millimeter Wavelengths. (2) Experimental Verification of Quantum Beats Due to Coherent Excitation of Nondegenerate Excited States by Sharply Pulsed Electron Impact, and (3) Spectroscopic Study of Cerium in Yttrium Gallium and Yttrium Iron Garnet. Author (TAB)

N66-14049# National Academy of Sciences—National Research Council, Washington, D. C. Subcommittee on Radiochemistry.
RADIOCHEMISTRY OF ARSENIC
Harold C. Beard (Florida State Univ.) and J. G. Cuninghame (Atomic Energy Res. Estab., Harwell, England) Washington, AEC, Nov. 1965 45 p refs Revised
(NAS-NS-3002, Rev.) CFSTI: $1.00

A detailed review is given of the radiochemistry of arsenic. Included are a summary of statistical physical properties of arsenic, table of isotopes, decay schemes, gamma spectra, relevant portion of chart of the nuclides, dissolution of arsenic samples, counting techniques pertinent to arsenic isotopes, and a collection of detailed radiochemical procedures. C.T.C.

N66-14061# Aeronautical Research Labs., Melbourne (Australia).
THE DETERMINATION OF CADMIUM IN STAINLESS STEEL BY ATOMIC ABSORPTION SPECTROSCOPY
L. Wilson Jul. 1965 11 p refs
(ARL/MET-244) CFSTI: HC $1.00/MF $0.50

Atomic absorption spectroscopy has been used for determining cadmium in stainless steel in contents down to 0.0003%. The method has been shown to be rapid, accurate, and free from interference, although allowance must be made for light scatter and reagent blanks. Author

N66-14085# Liege Univ. (Belgium).
RECENT RESEARCH ON ACTINIDES CHEMISTRY [ASPECTS RECENTS SUR LA CHIMIE DES ACTINIDES]
Werner Muller, Jean Goffart, Franco Caligara, and J. Kooi Brussels, EURATOM, 1965 68 p refs In FRENCH and ENGLISH Reprinted
(Contract EURATOM-003-61-02 TPUB)
(EUR-1240.f,e) CFSTI: HC $3.00/MF $0.75

The objectives of the Euratom program on transplutonium elements are summarized, and the work being undertaken on fundamental research and transplutonium element production is outlined. In another study, the mechanism of metal extraction by organic solutions of amine salts is examined, based on the analogy between amine extraction and anion exchange. The extraction of several trivalent actinides by trilaurylamine hydrochloride was compared with lanthanide and trivalent iron extraction. Results indicate that efficient separation of actinides from lanthanides is possible, and that group separations within the actinides may be feasible. Details are also given on the extraction of lanthanides and actinides by alkylphosphine oxides. The equipment and facilities used in the electrochemical study of transuranic elements in molten salt solutions are described, with emphasis placed on the construction and performance of the glove boxes. It is pointed out that these glove boxes allow work to be conducted in an inert and dry atmosphere, and are used for research on the electrochemical properties of $Pu^{3+}$ ions in LiCl–KCl eutectic solutions. M.G.J.

N66-14086# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
EXPERIMENTS ON THE ABSORPTION OF $N^{15}$ TAGGED $NH_4Cl$ INTO POTTED CORN [DIE AUFNAHME VON 15N-MARKIERTEM $NH_4Cl$ DURCH MAIS IM GEFASSVERSUCH]
E. Haunold, C. M. Cho, I. Shatokhin, and O. Danneberg [1965] 18 p refs In FRENCH Submitted for Publication
(SGAE-BL-15/1965) CFSTI: HC $1.00/MF $0.50

Nitrogen absorption during the growth and development of corn plants was studied by tracings of tagged nitrogen from fertilized soils. Potted plants showed the highest nitrogen content of about 4 percent during early growth, decreasing to a 1 percent level at maturity. Unfertilized plants had a much faster and also larger decrease of nitrogen content down to 0.6 percent at maturity. Spectral analytical evaluation of the overall nitrogen absorption pattern found that relative nitrogen absorption was highest in fertilized plants growing on poor soils. Transl. by G.G.

**N66-14067#** Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria).

**THE ISOLATION OF PURE STRONTIUM 89 AND BARIUM 140 FROM SHORT TIME IRRADIATED URANIUM THROUGH ION-EXCHANGE-CHROMATOGRAPHY [DIE ISOLIERUNG VON TRAGERFREIEM STRONTIUM-89 UND BARIUM-140 AUS KURZZEITIG BESTRAHLTEM URAN DURCH IONEN-AUSTAUSCHCHROMATOGRAPHIE]**

H. Titze [1965] 14 p refs In GERMAN Submitted for Publication

(SGAE-CH-17/1965) CFSTI: HC $1.00/MF $0.50

Pure strontium 89 and barium 140 were obtained by elution from irradiated uranium in a chlorine solution. Earth metals and rare earth elements were removed by cation exchange chromatography with a lactate buffer. Elution curves and $\gamma$-spectra of the obtained products showed a high degree of purity. G.G.

**N66-14099#** Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

**DETERMINATION OF TRITIUM CONTENT IN SAMPLES (A REVIEW), PART I [IL DOSAGGIO DEL TRITIO (RASSEGNA), PARTE I]**

F. Corti 24 Mar. 1965 66 p refs In ITALIAN

(ISS-65/8) CFSTI: HC $3.00/MF $0.75

After a brief description of the physical properties of tritium, of its use in scientific research and of its maximum permissible doses, some methods, used in preparing tritiated samples to be directly measured, are reviewed. Different processes in the handling of samples are described according to the materials and the measurement technique. After a brief explanation of the sensitivity limits of instruments, now on the market, some methods are described for enriching tritiated samples that are not sufficiently active. Author

**N66-14133*#** Israel Program for Scientific Translations, Ltd., Jerusalem.

**CHEMICAL THERMODYNAMICS IN NONFERROUS METALLURGY, VOLUME III: THERMODYNAMICS OF TUNGSTEN, MOLYBDENUM, TITANIUM, ZIRCONIUM, NIOBIUM, AND TANTALUM AND OF THEIR MORE IMPORTANT COMPOUNDS**

Ya. I. Gerasimov, A. N. Krestovnikov, and A. S. Shakhov 1965 245 p refs Transl. into ENGLISH of the book "Khimicheskaya Termodinamika V Tsvetnoi Metallurgii" Moscow, Gos. Nauchno-Tekhn. Izd. Literatury Po Chernoi I Tsvetn. Met., 1963 (NASA-TT-F-285; TT-65-50111) CFSTI: HC $6.00/MF $1.50 CSCL 07D

The thermodynamic properties of tungsten, molybdenum, titanium, zirconium, niobium, and tantalum are presented in this book. Also, the oxides, sulfides, halides, carbides, and nitrides of these metals are discussed. E.E.B.

**N66-14138#** Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.

**AN AEROSOL CLOUD: A PHYSICOCHEMICAL SYSTEM**

Albert Pfeiffer Oct. 1965 19 p refs

(CRDLR-3323; AD-623006) CFSTI: HC $1.00/MF $0.50

Experiments are described that lead to the suggestion that forces attract aerosol particles to air molecules, whereas thermal motion in the aerosol cloud causes the opposite effect. That tensile strength and surface tension of an aerosol cloud should be the consequences of the attracting forces is proved by the experiments reported. It is concluded that: (1) Forces attract aerosol particles to air molecules. (2) A cloud of fine aerosol possesses tensile strength and surface tension. Author (TAB)

**N66-14139#** Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.

**DIHYDROPYRAN DERIVATIVES OF SECONDARY AROMATIC AMINES**

Lawrence G. Vaughan and David N. Kramer Sep. 1965 18 p refs

(CRDLR-3326; AD-623007) CFSTI: HC $1.00/MF $0.50

3,4-Dihydropyran was found to form N-(2-tetrahydropyranyl) derivatives with a variety of secondary aromatic amines. The reaction is catalyzed by concentrated sulfuric acid. The structures of these compounds were established by infrared, ultraviolet, and nuclear magnetic resonance spectroscopy. The derivatives are stable as solids and in basic solution, but are decomposed in the presence of alcohols by traces of acid to regenerate the amines. Author (TAB)

**N66-14144#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**COVALENT METALLORGANIC COMPOUNDS OF TRANSITION ELEMENTS**

G. A. Razuvayev and V. N. Latyayeva 20 Sep. 1965 25 p Transl. into ENGLISH from Usp. Khim. (USSR), v. 34, no. 4, 1965 p 586–597

(FTD-TT-65-1263/1+4; AD-622476) CFSTI: HC $2.00/MF $0.50

The chemistry of the organometallic compounds of the transition elements of group IV is summarized. Methyl and ethyl replacement of chlorine atoms in titanium chloride; preparation of phenyltitanium chlorides; tetraphenyltitanium; dimethylbiscyclopentadienyltitanium; and zirconium and hafnium organic compounds are among those discussed. Oxidation, reduction, and thermal stability of these organometallic compounds are also considered. E.E.B.

**N66-14166#** United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

**THE DETERMINATION OF PLUTONIUM BY POTENTIOMETRIC TITRATION**

G. W. C. Milner, A. J. Wood, and G. E. Cassie Aug. 1965 28 p refs

(AERE-R-4975) HMSO: 5s

An improved method for the determination of plutonium by potentiometric titration has been developed. It is based on the oxidation of plutonium to the hexavalent state with argentic oxide, followed by reduction to the tetravalent state with ferrous ions added so as to give a small amount in excess. The excess ferrous is titrated with ceric sulphate added from an Agla microburette, and the end point is determined potentiometrically. A titrator has been developed to automate the addition of titrant and full details of the design are given. The burette and its motor drive have been designed so that they can be operated in a shielded facility. A precise method for the accurate determination of milligram amounts (1–10 mg) of plutonium has resulted, the precision being ~0.1% (1$\sigma$) at this level. This method has been used for the determination of the plutonium content of cermet samples, including PuC–Cr and $PuO_2$. $UO_2$–stainless steel. Author

**N66-14171#** Laboratories du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

**STUDIES ON THE SEPARATION OF CS 137 AND SR 90 FROM FISSION PRODUCTION IN AN ACID MEDIUM ON MINERAL ION EXCHANGERS Final Report**

L. H. Baetsle, D. Van Deyck, D. Huys, and A. Guery Brussels, EURATOM, Aug. 1965 77 p refs

(Contract EURATOM-028-62-4 RISB)

(EUR-2497.e) CFSTI: HC $3.00/MF $0.75

This report sums up the main features of the studies carried out from 1962 to 1964 on the recovery of $Cs^{137}$ and $Sr^{90}$ by means of new inorganic ion exchangers such as molybdenum ferrocyanide, tungsten ferrocyanide, polyantimonic acid, and the preparation and use conditions of these exchangers. Other work was performed on zirconium phosphate, the deacidification of solutions and the construction of a $Cs^{137}$ and $Sr^{90}$ separation cell. Author

**N66-14172#** Canadian Armament Research and Development Establishment, Valcartier (Quebec).

**STABILITY OF TRICALCIUM PHOSPHATE USED AS ANTI-CAKING AGENT WITH AMMONIUM PERCHLORATE**

R. Voyzelle Sep. 1965 13 p refs

(CARDE-TN-1674/65) CFSTI: HC $1.00/MF $0.50

Tricalcium Phosphate (TCP) used as an anti-caking agent in Ammonium Perchlorate (AP) was observed to decrease when the laboratory control analysis was carried out by estimating the insoluble calcium salt (TCP) in water. The analysis of phosphate and calcium ions in ammonium perchlorate containing tricalcium phosphate gave theoretical results. It was found that in an aqueous solution of TCP and AP an ion interchange occurred, resulting in a soluble phosphate salt. Another reaction between the two ingredients which resulted in the liberation of ammonia was observed. Author

**N66-14178#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**A METHOD OF OBTAINING SILICONE MONOMERS WITH A CYCLOPENTADIENE RADICAL**

M. K. Romantsevich, I. M. Shologon, N. F. Baranovskaya, N. N. Sirenko, and L. I. Kisina 23 Sep. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 165721 (Appl. No. 784334/23-4, 27 Jun. 1962) 2 p

(FTD-TT-65-432/1+4; AD-622447) CFSTI: HC $1.00/MF $0.50

The method of producing silicone monomers with a cyclopentadiene radical from sodium cyclopentadiene suspended in benzene and alkyl (aryl) haloid silanes is different in that alkyl (aryl) haloid silanes are added to a suspension of sodium cyclopentadiene in benzene at a temperature of −10 to 5° C to increase the yield of usable products. Author (TAB)

**N66-14179#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**METHOD OF OBTAINING N-FLUOROVINYL COMPOUNDS**

A. Ya. Yakubovich and A. P. Sergeyev 21 Sep. 1965 7 p Transl. into ENGLISH from Soviet Patent No. 166660 (Appl. No. 848911/23-4, 24 Jul. 1963) 1 p

(FTD-TT-65-523/1+4; AD-622450) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method for obtaining N-fluorovinyl compounds, which has the distinguishing feature that fluorinated olefins are subjected to interaction with N-metallic products of the general formula RR'NMe. Author (TAB)

**N66-14190#** Lockheed Missiles and Space Co., Palo Alto, Calif. Physical Sciences Lab.

**ABSORPTION COEFFICIENTS OF HEATED AIR: A COMPILATION TO 24,000° K, VOLUME II Final Report, 1 Apr. 1964–30 Jul. 1965**

D. R. Churchill, B. H. Armstrong, and K. G. Mueller Kirtland AFB, N. Mex., AF Weapons Lab., Oct. 1965 390 p

(Contract AF 29(601)-6320)

(AFWL-TR-65-132, Vol. II; AD-623370) CFSTI: HC $7.00/MF $1.75

An extensive tabulation of absorption coefficients of heated air was carried out with the aid of several large digital computer programs. These tables supersede the previous ones computed at Lockheed by Meyerott, Sokoloff, and Nicholls in 1959. Tables are presented for temperatures at every 1000K between 1000K and 24,000K and for eight densities between ten times normal atmospheric to 0.000001 times normal. Absorption coefficients are individually listed for each of 14 contributing absorbers. The photon energy range is 0.6–10.7 eV with a partition interval of 0.1 eV. Author (TAB)

**N66-14216#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**METHOD OF OBTAINING HALOGENATED TRICYCLIC ORGANOSILICON COMPOUNDS**

M. K. Romantsevich, I. M. Shologon, and L. I. Kisina 21 Sep. 1965 4 p Transl. into ENGLISH from Russian Patent no. 851138/23-4, 5 Aug. 1963 1 p

(FTD-TT-65-516/1+4; AD-622449)

The object of the invention is a method of obtaining halogenated tricyclic organosilicon compounds which has the distinguishing feature that for the purpose of expanding the raw-material base for the obtaining of heat-resistant polymers, cyclopentadienyl trichlorsilane or cyclopendadienyl alkyl (aryl) of haloid silane (see AD-622 447) is subjected to interaction with polyhalogen cyclopendadienes with heating in a medium of organic solution. Author (TAB)

**N66-14246*#** Stanford Univ., Calif. Instrumentation Research Lab.

**AN INVESTIGATION OF THE MASS SPECTRA OF TWENTY-TWO FREE AMINO ACIDS**

Nancy Martin 21 Sep. 1965 65 p refs

(Grant NsG-81-60; Grant NB-04270; Grant AF-AFOSR-886-65)

(NASA-CR-68768; IRL-1035) CFSTI: HC $3.00/MF $0.75 CSCL 06A

In preliminary study on operational problems for computer control, a time of flight mass spectrometer was used in an investigation of free amino acids. The sample was inserted directly into the source to a distance of 5 mm from the ionizing electron beam. The high data rate at the detector was reduced by an analog scanner, and the output applied to a conventional strip chart recorder or to an analog-to-digital converter for on-line evaluation by a digital computer. Experimental conditions are described, and thermal reactions of the free amino acids in vacuo are discussed. Fragmentation patterns of the acids in the mass spectrometer are depicted. Results indicate that free amino acids may be identified by their characteristic mass spectra. M.G.J.

**N66-14253#** Bureau of Mines, Berkeley, Calif.

**HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF TWO ZINC SULFIDES AND FOUR SOLID SOLUTIONS OF ZINC AND IRON SULFIDES**

L. B. Pankratz and E. G. King 1965 12 p refs

(BM-RI-6708)

Heat contents, measured above 298.15° K, and derived entropy increments are presented in tabular and equation form for the two crystalline forms of zinc sulfide (sphalerite and wurtzite) and for four solid solutions of iron and zinc sulfides having the compositions $Zn_{0.898}Fe_{0.102}S$, $Zn_{0.750}Fe_{0.250}S$, $Zn_{0.680}Fe_{0.380}S$, and $Zn_{0.498}Fe_{0.502}S$. Author

**N66-14270#** Joint Publications Research Service, Washington, D. C.
**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 255 (ANIONIC FREE RADICALS)**
Han-Wei Ts'eng 8 Dec. 1965 15 p refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), no. 10, 14 Nov. 1965 p 35–38
(JPRS-33209; TT-65-33784) CFSTI: $1.00

The formation, stability, and reactions of anionic free radicals /AFR/ are discussed. The effect that various solvents have upon the formation and stability of AFR is also considered. Reactions of AFR with halohydrocarbons are examined. The existence of AFR as intermediates in polymerization reactions, and the possible catalytic actions of AFR in polymerization reactions are investigated. M.R.W.

**N66-14296*#** General Electric Co., Evendale, Ohio. Materials Development Lab. Operation.
**BROMINE TRIFLUORIDE METHOD FOR OXYGEN IN LIQUID ALKALI METALS Second Quarterly Report, 1 Apr.–30 Jun. 1964**
Hyman Kirtchik, Thomas Lajcik, and Sigmond Culp 17 Jul. 1964 34 p
(Contract NASw-882)
(NASA-CR-68975; DM-64-277) CFSTI: HC $2.00/MF $0.50 CSCL 07A

This report describes the completed apparatus for determining oxygen in potassium by the $BrF_3$ method. The potassium extruder, the all monel $BrF_3$ handling apparatus, and the oxygen measuring device are described and pictured. Calibration of the extruder was done under a vacuum of $4 \times 10^{-6}$ torr and the weight of potassium extruded can be determined with less than a 1% error in the range between 0.25 and 1.0 grams. The calibration of the Brady apparatus has shown that less than one part per million of oxygen in a helium stream can be detected and measured. Author

**N66-14303#** Akron Univ., Ohio. Inst. of Rubber Research.
**LOW TEMPERATURE POLYMERIZATION Progress Report, 1 Jul.–30 Sep. 1965**
Maurice Morton 27 Oct. 1965 50 p refs
(Contract AF 04(611)-9694)
(PR-7; AD-623307) CFSTI: HC $3.00/MF $0.50

Further investigation of the radiation polymerization of fluoral in methylene chloride confirmed that a rate relation of the form Rp = kp ((M) (M)/S), (where M = monomer, and S = solvent) can be applied over a range of monomer concentration from 1 to 6 molar. This can be taken as evidence for termination by reaction with the methylene chloride. The results are consistent with a preferred anionic mode of polymerization of this monomer. Other experiments have shown that fluoral is very readily polymerized by bases, even by such weakly basic compounds as dimethylformamide. The polymerization of the fluorovinyl monomers is probably caused by the high energy radical-cation formed as a result of primary radiolysis, i.e. (using VF as an example): $CH_2{=}CH_2$ + photon (—) $\cdot CH_2CHF(+)$ + e(—). This species can polymerize as a cation or as a radical; however, at low temperature the cation reaction is the more vigorous: $\cdot CH_2CHF(+)$ + VF (—) $\cdot(CH_2CHF)_m(CH_2CHF)(+)$. TAB

**N66-14319#** Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
**REVERSIBLE OXYGEN ELECTRODES First Quarterly Report, 14 Apr.–31 Jul. 1965**
M. Genshaw, K. Wong, and A. Damjanovic [1965] 20 p
(Contract DA-28-043-AMC-01291(E))
(Rept.-1; AD-623660) CFSTI: HC $1.00/MF $0.50

The mechanism of oxygen reduction on the surface of gold electrodes was studied using a rotating disk electrode with a ring. In acid solution hydrogen peroxide is the product of the reduction. In alkaline solutions hydrogen peroxide is an intermediate during the reduction. By oxidation and reduction small areas on the gold surface become more active and reduce oxygen directly to water. Author (TAB)

# 07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

**N66-13305** Joint Publications Research Service, Washington, D. C.
**DETECTION AND MEASUREMENT OF THE PARAMETERS OF A RANDOM NUMBER OF SIGNALS BELONGING TO DIFFERENT CLASSES**
I. A. Bol'Shakov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 43–57 refs (See N66-13301 04-10) CFSTI: $6.00

Possibilities are expanded for a theory dealing with the separation of many noises from signals by consideration of signals of different classes. The use of correlated random points permits automatic consideration of interclass signals which are statistically indistinguishable, and also solves the problem of recognition. An optimal operator is constructed for simultaneous detection and measurement of the signal parameters of several classes and the signals of one class against a background of others. Regular and fluctuating signals in white noise are investigated. M.W.R.

**N66-13307** Joint Publications Research Service, Washington, D. C.
**A SINGLE LINE QUEUEING SYSTEM WITH LOSSES**
O. I. Bronstein, A. L. Raykin, and V. V. Rykov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 64–74 refs (See N66-13301 04-10) CFSTI: $6.00

A single line queueing system is investigated with losses to which N simple (with parameters $\lambda_i$, $i = \overline{1, N}$) flows of demands arrive. The random time of servicing a demand of the i-th flow has an exponential distribution with the parameter $\mu_i$. The operation of this system under two conditions is investigated: with priorities and without them. The stationary probabilities of total servicing of the demands from each and from the total flows are investigated. A series of priorities is found for which the fraction of complete servicing of demands from the total flows is maximal Author

**N66-13317** Joint Publications Research Service, Washington, D. C.
**OPTIMAL SEARCH FOR THE MAXIMUM OF A MODULUS FUNCTION IN THE PRESENCE OF NOISE**

K. Sh. Zigangirov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 166–172 refs (See N66-13301 04-10) CFSTI: $6.00

The problem is investigated of most rapid search for the maximum of a modulus function $\phi(x) = b - a|x - \gamma|$ in the presence of additive noise. The optimal procedure is a variation of the Wald sequential analysis. The expressions obtained for the average search time are limiting in nature. Author

**N66-13346** Library of Congress, Washington, D. C. Aerospace Technology Div.
**NEW COMPACT ANTENNA (USSR)**
*In its* Foreign Sci. Bull., Vol. 1, No. 10 Oct. 1965 p 37–39 (See N66-13340 04-34)

A new compact antenna with an omnidirectional radiation pattern for use in air navigation or TV broadcasting is reported. The antenna operates in the centimeter band, and the pattern in the horizontal plane is circular, with a deviation of less than ±2db for a 12% frequency band. Half-power beamwidth in the vertical plane does not exceed 6° Author

**N66-13387#** Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
**LEAST MEAN SQUARE ERROR ANALYSIS OF PCM TRANSMISSION**
Ian T. Young Oct. 1964 17 p refs *Its* Phys. Sci. Res. Papers No. 62
(AFCRL-64-864; AD-608782) CFSTI: HC $1.00/MF $0.50

Optimal energy distribution applied to a least mean square error criterion for PCM transmission is discussed. Comparisons are drawn between the optimized scheme and standard scheme for: (1) White Noise Channel (2) White Noise and Rayleigh Fading Channel. It is concluded that for few bit samples only small energy savings are attained. Author (TAB)

**N66-13394#** Joint Publications Research Service, Washington, D. C.
**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 245 (TROPOSPHERIC SCATTERING COMMUNICATIONS)**
23 Nov. 1965 21 p refs Transl. into ENGLISH from Tien-Tzu Chi-Su (Shanghai), nos. 11 and 12, Nov. and Dec. 1964 p 19–20, 14–16
(JPRS-32989; TT-65-33566) CFSTI: $1.00

CONTENTS:
1. TROPOSPHERIC SCATTER COMMUNICATIONS (I) T.-y. Wu p 1–9 (See N66-13395 04-07)
2. TROPOSPHERIC SCATTER COMMUNICATIONS (II) T.-y. Wu p 10–19 refs (See N66-13396 04-07)

**N66-13395** Joint Publications Research Service, Washington, D. C.
**TROPOSPHERIC SCATTER COMMUNICATIONS (I)**
Te-Yen Wu *In its* Transl. on Communist China's Sci. and Technol. No. 245 23 Nov. 1965 p 1–9 (See N66-13394 04-07) CFSTI: $1.00

A brief introduction to the physical phenomena associated with troposcatter propagation, the methods used to calculate scatter networks, and the prospects for future development in the field of tropospheric scatter communications are presented. It is concluded that current theories on wave propagation and scattering in the troposphere have definitie limitations. Efforts must be directed on experiments designed to advance the understanding of the structure of the atmosphere to effect a systematic and complete collection of data relating to the relationship between incoming field and distance, wavelength, directionality of antenna, and meteorological conditions. From such data a more integrated theory can be devised to predict the fields in troposcatter propagation. E.E.B.

**N66-13396** Joint Publications Research Service, Washington, D. C.
**TROPOSPHERIC SCATTER COMMUNICATIONS (II)**
Te-Yen Wu *In its* Transl. on Communist China's Sci. and Technol. No. 245 23 Nov. 1965 p 10–19 refs (See N66-13394 04-07) CFSTI: $1.00

The effect of the scattering angle on scattering transmission losses; signal fading and diversity reception; antenna gain drop; and the total loss in the scattering network are analyzed. Also, the selection of carrier-wave frequency; frequency modulation in troposcatter; and the transmitter, receiver, and antenna systems are discussed. Narrow-band scatter systems; automatic bandpass control; automatic control of carrier-wave power; selection of optional transmission power; the application of numerical signal transmission; the utilization of angular diversity to reduce drops in the antenna gain; and the application of low-noise tunnel diodes are considered as aspects of scatter communications which are currently under study. E.E.B.

**N66-13454#** Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
**A SYNTHESIS PROCEDURE FOR CERTAIN NETWORKS OF TRANSMISSION LINES WITH REACTIVE TERMINATIONS**
Stuart Jay Sinder Sep. 1965 76 p refs
(Contract AF 33(615)-1274)
(EERL-38; AFAL-TR-65-227; AD-472736)

Basic network elements are defined and the mapping properties of the corresponding frequency transformation are discussed. Butterworth bandpass transmission-line filters are considered, and it is shown that reactance-terminated stub networks can yield greater bandwidth at reasonable characteristic impedance levels than is the case with simple open-circuit and short-circuit stubs. The definition of the two-variable reactance property (tvrp) is given, and an application of the theory of functions of two complex variables to the synthesis of reactance-terminated transmission-line networks is discussed. The consequences of a more basic realization of the basic reactance-terminated network elements are presented. Some physical interpretations of the basic network elements are described, along with their use for simple Cauer realization. A Cauer expansion method for driving-point function realization is developed, as is a procedure for the realization of a driving-point function in a general ladder network of the basic elements. Illustrative examples of both methods are given. Networks consisting entirely of inductive-terminated elements or entirely of capacitance-terminated elements and networks in special ladder form are investigated. Necessary and sufficient conditions are developed for networks with one or two degrees of freedom. Author (TAB)

**N66-13460#** Michigan Univ., Ann Arbor. Radiation Lab.
**ANALYTICAL AND NUMERICAL STUDIES OF THE BACK SCATTERING BEHAVIOR OF SPHERES**
T. B. A. Senior Jun. 1965 106 p refs
(Contract AF 04(694)-683)
(Rept.-7030-1-T; AD-471260)

When a smooth convex body is illuminated by a plane wave, an important feature of the electromagnetic scattering is the effect of the creeping waves which are launched in the vicinity of the shadow boundary and contribute to the back

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scattered field after having traversed the rear. Although usually regarded as a high frequency phenomena appropriate only when the radii of curvature are large in comparison with the wavelength, studies of data for the back scattering of a plane electromagnetic wave by a perfectly conducting sphere suggest that the concept is still valid for ka as small as unity. A relatively simple expression for the creeping wave component is found to be accurate for all ka greater than 1.
Author (TAB)

**N66-13461#** Navy Electronics Lab., San Diego, Calif.
**ANTIPODAL-FIELD MEASUREMENTS OF VLF TRANSMITTER NPM AT STATIONARY SITES, DECEMBER 1962–FEBRUARY 1965**
F. P. Synder, J. E. Bickel, and M. R. Paulson 27 May 1965 200 p refs
(NEL-1294; AD-473393)

Time variations of antipodal fields of NPM, broadcasting on 19.8 kc/s in Hawaii, were measured at four fixed stations from 11 to 29 July 1963. Amplitude data are presented in terms of absolute field intensity. A preliminary analysis of the data is presented. Author (TAB)

**N66-13502#** Weapons Research Establishment (Australia).
**A METHOD FOR THE ROUTINE DETERMINATION OF RADAR REFRACTION CORRECTIONS**
B. Davies and R. H. Evans Aug. 1965 37 p refs
(WRE-TN-TRD-13) CFSTI: HC $2.00/MF $0.50

Equations to compute radar refraction corrections have been developed based on an approximate solution of the fundamental differential equation describing the ray path. The method requires a description of the refractive index profile represented by a model-profile equation or a table. The correction equations are suitable for application to radar information sampled at a frequent rate since they are simple to apply and do not expend much computing time. They seem suitable for incorporation into the W.R.E. data reduction facility. The proposed correction equations have been used and the results compared with more exact numerical solutions of the differential equation for a few representative refractive index profiles. The errors were smaller than those generally introduced into radar output from other sources and the equations are thus concluded to be sufficiently accurate. Author

**N66-13508#** National Bureau of Standards, Boulder, Colo.
**MICROWAVE IMPEDANCE MEASUREMENTS AND STANDARDS**
Robert W. Beatty 12 Aug. 1965 37 p refs
(NBS-Monograph-82) GPO: $0.20

A survey and discussion of microwave impedance measurement techniques is presented. The discussion includes an introduction which emphasizes basic concepts and reflection coefficients. Sources of error in the various techniques are discussed and methods to reduce errors are presented. The discussion of errors in slotted line and reflectometer techniques is most thorough. Methods using rotating loops and resonance lines are included and a brief discussion of microwave impedance standards is given. Author

**N66-13559*#** Stanford Univ., Calif. Radioscience Lab.
**CODING SCHEMES FOR ADDITIVE NOISE CHANNELS WITH FEEDBACK Scientific Report No. 10**
J. P. M. Schalkwijk Aug. 1965 58 p refs
(Contract NsG-377)
(NASA-CR-68651; SEL-65-073) CFSTI: HC $3.00/MF $0.50
CSCL 09D

For one-way transmission that is not subject to a bandwidth constraint, orthogonal codes are known to achieve the capacity of the additive white gaussian noise channel. For a transmitted signal that is subject to a bandwidth constraint, no deterministic way of constructing a code achieving channel capacity has been known. The first such code—for the noiseless feedback case—is developed in this study. It is known that a noiseless feedback channel does not improve the capacity of the discrete memoryless forward channel; however the feedback channel may reduce the coding effort. Two new coding schemes using feedback are developed and the influence of feedback noise on each is investigated. The WB coding scheme achieves capacity for the wideband ($W \rightarrow \infty$) case and the BL coding scheme achieves capacity for the bandlimited case. The latter scheme could be very important for satellite communications since it allows for a substantial decrease of the coding effort while permitting the satellite to transmit its information at a rate arbitrarily close to channel capacity. Author

**N66-13579#** Illinois Univ., Urbana. Antenna Lab.
**RADIATION FROM SOME PERIODIC STRUCTURES EXCITED BY A WAVEGUIDE Technical Report No. 7**
D. S. Karjala and R. Mittra Oct. 1965 76 p refs *Its* Antenna Lab. Rept.-65-15
(Contract AF 19(628)-3819)
(AFCRL-65-653; AD-623133) CFSTI: HC $3.00/MF $0.75

The problem of radiation from a set of semi-infinite parallel plates, as well as those of radiation from uniform and modulated corrugated surfaces excited by a parallel plane waveguide, are solved exactly. The method used is an extension of the conventional mode matching technique so that it is applicable to open structures. A Fourier transform taken perpendicular to the plates and matching across the plane which separates the structure and the semi-infinite region into which it is radiating, taken together with certain periodicity properties of the unknown functions in the transform domain, allows generation of an infinite set of algebraic equations which may be solved exactly. From the solution of these equations nearly all results of interest may be obtained: the reflection coefficient, the mode coefficients, which represent the field in the structure, the radiation pattern, the k-beta diagram, and the amplitudes of the surface waves launched. Fairly extensive numerical results for these quantities were obtained. Author (TAB)

**N66-13697#** Hughes Aircraft Co., Culver City, Calif. Research and Development Div.
**LEAKY WAVES AND THEIR APPLICATION TO SINGLE APERTURE MULTIPLE BEAM ANTENNAS Scientific Report No. 4**
J. H. Harris Aug. 1965 25 p refs
(Contract AF 19(628)-4349)
(P65-99; AFCRL-65-672; AD-622403) CFSTI: HC $2.00/MF $0.50

The character of electromagnetic fields in layered plasma environments, excited by point sources, is investigated, with particular interest in the leaky waves. Experimental verification of the nature of the waves is shown. A new multiple beam antenna technique is presented and demonstrated by a two-channel model. Author (TAB)

**N66-13713#** Stanford Research Inst., Menlo Park, Calif.
**AN EXPERIMENTAL STUDY OF NONLINEAR PLASMA-WAVE INTERACTION Scientific Report No. 1**
William C. Taylor Aug. 1965 41 p refs
(Contract AF 19(628)-4800)
(AFCRL-65-654; AD-622876) CFSTI: HC $2.00/MF $0.50

A study was made of the effect of pulsed L-band radiation from a slot antenna upon a layer of hot ionized air passing over the slot, and of the resulting time-resolved radiated power received by a monitoring antenna well beyond the plasma layer. The plasma layers were produced by an RF plasma jet and were nonuniform in electron density and collision frequency, similar to those expected in hypersonic flight through densities ranging between 0.0001 and 0.001 atmospheres. The plasma frequency at the maximum was varied between about one-tenth and twice critical. Measurements were made of the RF power thresholds required for producing (1) perceptible electron heating and (2) perceptible additional attenuation produced by RF-induced changes in the plasma conductivity. At low pressures, the electron heating thresholds were found to be considerably lower than required for breakdown in cold air at the same pressure. The thresholds for additional attenuation over the pressure range were about 8 db below the usual breakdown levels in cold air. The variation with pressure of power transmitted through the resulting plasma corroborates earlier experiments with discharges in cold air in a waveguide, showing a monotonic decrease as pressure decreases when the input power is much higher than the threshold required for nonlinear interaction. Author (TAB)

**N66-13714#** Rome Air Development Center, Griffiss AFB, N. Y. Display Techniques Branch.

**RELATIVE INFLUENCE OF TIME, COMPLEXITY, AND DENSITY ON UTILIZATION OF CODED LARGE-SCALE DISPLAYS Final Report, Jun. 1964–Mar. 1965**

William R. Dyer and Raymond J. Christman Sep. 1965 23 p refs

(RADC-TR-65-325; AD-622786) CFSTI: HC $1.00/MF $0.50

A study was accomplished to demonstrate the influence of display coding on a task of locating and identifying specific entries in a numerical matrix. Various relationships among factors of matrix size, complexity, and viewing time were determined and are presented in graphic form. In addition to demonstrating the expected efficacy of coding, several additional findings were revealed. It was found that coding is of particular value when search time is limited, and that as the difficulty of the task increases the value of coding also increases. It was also shown that with longer search times available, the relative value of coding appeared to increase. This finding was interpreted as the result of a two-stage data extraction effort: the first stage being a locating of the pertinent data entries, the second stage being the actual reading of the displayed values. Author (TAB)

**N66-13751#** Library of Congress, Washington, D. C. Aerospace Information Div.

**PASSIVE ELECTRONIC INTERCEPT TECHNIQUES AND DEVICES Review of Soviet Literature**

A. I. Samoylov et al 18 Mar. 1964 83 p refs Compilation of Abstracts

(AID-O-64-15; AD-622235) CFSTI: HC $3.00/MF $0.75

Abstracts are compiled from Soviet open-source materials on passive electronic intercept techniques and devices. The following topics are considered: receiving equipment; receive detection techniques; direction finding techniques; antennas; atmospheric propagation; data transmission and recording. TAB

**N66-13762#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**HORIZONTALLY POLARIZED OMNIDIRECTIONAL RADIATION CLOSE TO A CONDUCTING PLANE**

Frank Goff Alexander and Oakley Glynn Vincent (M.S. Thesis) Aug. 1965 103 p refs

(GE/EE/65-2; AD-622989) CFSTI: HC $4.00/MF $0.75

A loop antenna is simulated by four end-fire arrays. The effects of three methods to increase the intensity of the E (tan) component of radiation near a conducting ground are shown. The theoretical basis for the three methods are given. A combination of two of the methods, namely, trapped modes in a dielectric slab excited by a parallel plane waveguide, given field patterns with major lobes near the plane of the ground. This combination shows promise of giving a gain of 14 db near the plane of a finite ground if no limitations on the length of dielectric are imposed. Author (TAB)

**N66-13771#** RAND Corp., Santa Monica, Calif.

**LINEAR AND NONLINEAR FILTERING THEORY**

Richard S. Bucy Sep. 1965 15 p refs

(Contract AF 49(638)-700; Proj. Rand)

(RM-4735-PR; AD-620927) CFSTI: HC $1.00/MF $0.50

This paper is a written version of a talk to be given on problems of filtering theory. It is a review of the linear theory and some of the recent fundamental advances in the nonlinear theory. Some open and quite interesting problems in the nonlinear theory are discussed. Author (TAB)

**N66-13794#** Illinois Univ., Urbana. Radiolocation Research Lab.

**THE PROPAGATION OF CURRENT ALONG INFINITE SINUSOIDAL TAPES Technical Report No. 13**

John William Greiser Sep. 1965 87 p refs Antenna Lab. Rept.-65-14

(Contracts NObsr-89229; NObsr-183402)

(RRL-289; AD-622910) CFSTI: HC $3.00/MF $0.75

The propagation and radiation characteristics of electric current on infinite sinusoidal conducting tapes are studied. The determinantal equation for the propagation constant is derived for both planar and ribbon tapes. With the aid of a digital computer the determinantal equation for the planar tape is solved and the results are plotted in the form of Brillouin or dispersion diagrams. The approach used to investigate the propagation characteristics of sinusoidal tapes is based on Floquet's theorem and a Fourier expansion of the space variation of the electric current on the tape structure. A filamentary electric current is assumed to be flowing along the center line of an infinite, perfectly conducting, sinusoidal tape. The current is expressed as the infinite summation of space harmonics of unknown amplitude. From the expansion for the current the vector potential is derived and thence the expressions for the electric field everywhere. An equation involving the fundamental propagation constant alone is solved approximately with numerical procedures on a digital computer, and the unknown current space harmonic amplitudes are determined. TAB

**N66-13803#** Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.

**AN F-M SWEEP INTEGRATOR FOR QUANTITATIVE RADAR DISPLAYS**

Donat U. Hoegl Mar. 1965 30 p refs

(Contract DA-36-039-AMC-02225(E))

(RR-37; AD-620852) CFSTI: HC $2.00/MF $0.50

A system which displays radar weather echoes quantitatively is described. The video signal from a logarithmic receiver is averaged in a delay line integrator to reduce its fluctuations about the mean value, and a correction is applied to compensate for the spreading of the radar beam with range. It

is then quantized into ten levels and displayed on plan position or range height indicators. Both block diagrams and detailed circuit diagrams are included. advantages of this system over earlier delay line integrators for weather echoes result from the use of frequency modulation in the delay line loop. After integration of 24 pulses, the standard deviation of the fluctuating signal is reduced to approximately 20 percent as compared with 100 percent for no integration at all. Author (TAB)

**N66-13804#** American Meteorological Society, Boston, Mass.
**THE APPLICATION OF INFORMATION THEORY TO PHOTOGRAPHIC SYSTEMS [O PRIMENENII TEORII INFORMATSII K FOTOCRAFICHESKIM SISTEMAM]**
D. S. Lebedev Bedford, Mass., AFCRL Jul. 1965 25 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 10, no. 1, 1965 p 62–71
(Contract AF 19(628)-3880)
(T-R-478; AD-621421) CFSTI: HC $1.00/MF $0.50

The aim of the paper is to examine and answer the question: How is information theory related to the problems of perfecting photographic systems. Some of the conclusions reached are as follows: (1) To describe the properties of photographic systems, it is advantageous to use an analogy between these systems and other systems of information storage and transmission (in particular, systems of electrical communication). This analogy follows from the general conceptions of information theory. (2) The obstacle in the path of developing optimum photographic systems is the lack of criterion of the fidelity of reproduction of images, i.e., a criterion of the closeness (similarity) of images from the viewpoint of the recipient. Such a criterion must be established by the methods of biophysical or psychological research (and not by information-theory methods). (3) Strictly information-theory concepts (viz., quantity of information, entropy, and capacity) have a rather limited application to photographic systems, because these concepts apply to the measurement of the efficiency of encoding and decoding, and it is nearly impossible to carry out these operations by purely photographic methods. Author (TAB)

**N66-13807#** RAND Corp., Santa Monica, Calif.
**CLASSES OF SIGNAL PROCESSING PROCEDURES SUGGESTED BY EXACT MINIMUM MEAN SQUARE ERROR PROCEDURES**
P. Swerling Sep. 1965 50 p refs
(P-3029-1; AD-622411) CFSTI: HC $2.00/MF $0.50 CSCL 09D

This paper investigates certain classes of data-smoothing procedures for use in problems where the objective is to estimate a set of parameters, on the basis of observed data which depend on these parameters and are also corrupted by noise. These procedures are in part motivated by possible application to orbit estimation problems, which the author believes may provide instances where the suggested procedures are computationally more convenient than those more commonly employed. However, potential applications exist to many other parameter estimation problems. TAB

**N66-13808#** Ohio State Univ. Research Foundation, Columbus.
**ANTENNA LOBE SUPPRESSION. VOLUME V: GRATED REFLECTOR ANTENNAS FOR SPURIOUS RADIATION REDUCTION Final Report**
Richard E. Lawrie Griffiss AFB, N. Y., RADC, Oct. 1965 28 p refs
(Contract AF 30(602)-3269)
(RADC-TR-65-186, Vol. V; RF-1767-6; AD-623076) CFSTI: HC $2.00/MF $0.50

A method of reducing the radio frequency interference resulting from radiation at spurious frequencies by utilizing the frequency sensitivity of grating reflectors is examined. A technique is presented whereby the attenuation in a radial-wedge waveguide operating beyond cutoff may be calculated. Author (TAB)

**N66-13818#** Navy Underwater Sound Lab., New London, Conn.
**SOME NOTES ON THE UTILIZATION OF A VERTICAL MAGNETIC DIPOLE TO DETERMINE THE PROPERTIES OF A STRATIFIED EARTH**
Peter R. Bannister 5 Oct. 1965 36 p refs
(USL-695; AD-622228) CFSTI: HC $2.00/MF $0.50

The fields of a vertical magnetic dipole (VMD) located over a stratified earth are derived for the quasi-static range ($|\gamma_0\rho| << 1$) and $z = h = 0$. It is demonstrated that the VMD method may be used in connection with the dipole-dipole method in order to resolve the electrical properties of a simple three-layer model earth ($\rho_1 << \rho_2 >> \rho_3$). Author (TAB)

**N66-13823#** Electronic Associates, Inc., Long Branch, N. J.
**VOICE ACTUATED ADDRESS MECHANISM Quarterly Progress Report, 1 Mar.–31 May 1965**
Donald Fraipont 14 Jul. 1965 97 p *Its* Rept.-1
(Contract DA-28-043-AMC-01223(E))
(QPR-1; AD-620941) CFSTI: HC $3.00/MF $0.75

This report on the simulation of VAAM includes the full design of the preprocessor as implemented on the TR-48 analog computer and also the design of the programs utilized by the Digital Operations System-350. For reasons of efficiency the Phase I effort was broken into three tasks. First, recordings of various speakers voicing the vocabulary words were digitized and punched on paper tape. Second, the paper tapes were input to the DDP-24 digital computer to train VAAM to recognize the vocabulary. Third, the reference functions created in the learning task were evaluated by using voiced inputs directly on-line with the full system. It was found that the sample of single voicings by 26 speakers was an inadequate training set for a good extrapolation recognition rate. The extrapolated recognition rate was approximately 55 percent, ranging from 35 to 80 percent for different speakers. An attempt at improving results by on-line training pointed out the inefficiency of this mode of operation, and the improvement was small. The conclusions are that the approach of the Andromeda, Inc., algorithm is feasible but more training is required. The training must be automated by adding some mass storage medium such as digital magnetic tape to the system. Author (TAB)

**N66-13839*#** Texas Univ., Austin.
**RADIO ASTRONOMY SIGNAL SPECTRUM ANALYSER**
John J. Sizelan (M.S. Thesis) Sep. 1965 33 p refs
(Grant NsG-432)
(NASA-CR-68780) CFSTI: HC $2.00/MF $0.50 CSCL 09F

A study is presented in which a device was developed for automatically processing data from the receiver of a radio telescope. The requirements of the device are: to sample the data, to store the data for comparison with later scans, to sum data from corresponding times of a large number of scans, and to present the composite scan. The unique requirement of the device is to perform these functions at the receiver site with a minimum number of components. Essentially, the device consists of a trigger determining the instants when samples of the signal are taken, an analog to digital converter, crossbar drive transistorized monostable multivibrators, and a register consisting of 500 magnetic counters. C.T.C.

**N66-13841*#** Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
**AN INVESTIGATION OF SECOND-ORDER CORRECTIONS TO FIRST-ORDER RAY THEORY AS APPLIED TO BEACON SATELLITE TRANSMISSION STUDIES**
Nevin D. Foltz 15 Nov. 1965 40 p refs *Its* Sci. Rept.-225
(Grant NsG-114-61)
(NASA-CR-68764) CFSTI: HC $2.00/MF $0.50 CSCL 09F

A review of the first-order ray theory of wave propagation through the ionosphere is presented as an introduction to the second-order ray theory. Both theories embody equations useful to the study of the total integrated electron content, $N_T$, of the ionosphere. Using simultaneous polarization rotation and dispersive doppler records of the Transit 4A Beacon satellite, the relative accuracy of the two theories is investigated. Results indicate that the second-order theory provides a more accurate means with which to compute $N_T$, and that mean ionospheric height variation with direction is a further factor which must be considered in more accurate data reduction programs. Author

**N66-13900#** Compagnie Generale de Telegraphie sans Fil, Paris (France).
**PASSIVE SATELLITE SYSTEM FOR EUROPEAN TELEVISION BROADCASTING**
C. Plottin 14 Jan. 1965 37 p refs
(Rept.-5.023 A) CFSTI: HC $2.00/MF $0.50

The feasibility of a television transmission system based on the use of a large stabilized reflecting satellite placed in a 24 hour equatorial orbit was considered. Such a satellite would be of the retro-directive type and would permit a wide variation in the incident angle of radiation, thereby allowing access from a number of widely separated geographical points. It is shown that a single passive satellite could thus serve the television transmission needs of the major part of Europe. Basically the system consists of a high-power transmitter centrally located in the area to be served, the satellite reflector itself, and ordinary home receivers possibly modified to a minor extent for direct reception of television broadcasts. It is demonstrated that the values of the parameters (satellite size, transmitter power, antenna characteristics, field strength at the receiver, etc.) necessary for realization of such a project are within reason. Author

**N66-13987#** Columbia Univ., New York. Dept. of Electrical Engineering.
**TRANSMISSION LOSSES OF HYBRID SURFACE WAVES ON THE V-LINE Scientific Report No. 84**
Paul Diament, Stephen L. Richter, and S. Perry Schlesinger 12 Jul. 1965 35 p refs
(Contract AF 19(628)-2461)
(CU-13-65-AF-2461-EE; AFCRL-65-557; AD-623123) CFSTI: HC $2.00/MF $0.50

Transmission losses of the V-line, a surface wave guiding structure comprising a cylindrical dielectric binding medium of sectoral cross section supported by a wedge formed by two conducting plates, are considered. Analytic expressions for both the dielectric and conduction losses are derived for the hybrid modes and presented graphically. On the basis of these, criteria are given for minimizing the attenuation due to both losses. Included are methods to calculate intractable integrals of products of modified Bessel functions to high accuracy. Author (TAB)

**N66-13994#** National Bureau of Standards, Boulder, Colo.
**RADAR NOISE DATA Quarterly Report, Mar.–May 1964**
W. Q. Crichlow, R. T. Disney, and M. A. Jenkins 2 Aug. 1965 96 p refs
(NBS-TN-18-22) GPO: $0.50

Radio noise measurements were made at eighteen stations in a world-wide network operated in a cooperative program operated by the National Bureau of Standards. The locations of these stations are shown on a map. The results of these measurements for the months of March, April, and May are presented in tabular form under the headings of month-hour values of radio noise, and seasonal time-block values of radio noise. The tabulated values are based on three basic parameters of noise, the mean power, the mean envelope voltage, and the mean logarithm of the envelope voltage. Formulas used in expressing these parameters are given. L.S.

**N66-14003#** New York Univ., N. Y. Lab. for Electroscience Research.
**RADIATING SLOTS ON A DIELECTRIC FILLED WAVEGUIDE Annual Report, 1 Jul. 1964–30 Jun. 1965**
Bernard R. Cheo and Louis Pelish 1 Aug. 1965 76 p refs
(Contract DA-49-186-AMC-183(D))
(TR-400-118; AD-623206) CFSTI: HC $3.00/MF $0.75

The use of dielectric filling in waveguide slot antennas is practiced mainly because of size and weight reduction. The equivalent circuits of a single radiating slot are discussed, and their lumped circuit elements determined. It is found that the behavior of a slot is retained while only the resonant length is shifted through dielectric loading. A new method of achieving electronic scan of these antennas by continuous loading of a ferrite slab in the guide is discussed. Data are compiled on the propagation constants and losses of a uniform dielectric loaded waveguide over a wide range of operating conditions. TAB

**N66-14018#** RAND Corp., Santa Monica, Calif.
**TOPICS IN GENERALIZED LEAST SQUARES SIGNAL ESTIMATION**
P. Swerling Sep. 1965 71 p refs
(P-3007-1; AD-622410) CFSTI: HC $3.00/MF $0.75

This paper is concerned with the various mathematically equivalent forms which can be taken by the maximum likelihood, maximum a-posteriori, and least squares approaches to the estimation of signals. R.N.A.

**N66-14036#** RAND Corp., Santa Monica, Calif.
**FACTORS AFFECTING CODING ERRORS**
Sidney Owsowitz and Anders Sweetland Apr. 1965 37 p
(Contract AF 49(638)-700; Proj. RAND)
(RM-4346-PR; AD-614415) CFSTI: HC $2.00/MF $0.50

This memorandum describes experiments which sought to identify the factors that contribute to coding errors. The experiments used code-stimulus materials: numeric codes, consisting only of numbers; alpha codes, consisting only of letters; alpha-numeric codes of mixed letters and numbers; and mnemonic codes (natural abbreviations, such as 'OVH' for 'overheated'). Only three-character codes were used. Major findings were: (1) Coding errors are proportional to the alpha content. (2) Errors committed with mixed codes reveal a position effect. (3) Perceptual set can increase or reduce error rates. (4) There was evidence of interaction (in the statistical sense) among the first, second, and third variables. (5) Unless perceptual set is specifically controlled most errors in recording mixed codes consist of 'substitutions of opposites'. (6) Over half the erroneous substitutions appeared to be non-random. (7) Non-random substitutions tended to be unidirectional. (8) Most coding errors (75 to 95

percent) result from having a single digit in error. (9) The use of mnemonic codes did not reduce coding errors. (10) Letter-pattern familiarity affects coding errors. (11) Coding errors can be substantially reduced by providing keypunchers with a list of codes. (12) The amount of usable information that is retrievable from coded information depends on three factors: (a) the error rate; (b) the number of codes used; and (c) the number of codes possible with the format in question. TAB

**N66-14048#** Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
**RADIOMETRY**
Fred E. Nicodemus 15 Mar. 1965 118 p refs
(EDL-G324)

A review is given of the language of radiometry (terminology, symbols, and units), basic physical laws and principles, measurement techniques and instrumentation, as well as the common sources of error in radiometric calibration and measurement. The treatment is in terms of classical radiometry, based on the geometrical optics of incoherent radiation. C.T.C.

**N66-14053*#** Ohio State Univ., Columbus.
**APPLICATION OF WEDGE DIFFRACTION TO ANTENNA THEORY**
R. C. Rudduck Washington, NASA, Jan. 1966 65 p refs
(Grant NsG-448)
(NASA-CR-372) CFSTI: HC $3.00/MF $0.75 CSCL 20M

The method of applying geometrical optics techniques to diffraction by antennas and scattering bodies is outlined. The basic technique employs diffraction by a conducting wedge, and may be applied to antennas and scatterers which can be modeled from wedges. Three formulations of the solution to wedge diffraction are used for various conditions of application. The basic characteristics of each formulation is discussed. The method is discussed in detail by application to calculation of the radiation patterns of parallel-plate waveguides. The treatment of radiation patterns of pyramidal horn antennas and rectangular waveguides, and diffraction by thick walls is outlined. The application of this method to analytical determination of gain, effective aperture, and aperture admittance of parallel-plate guides and coupling between guides is discussed. Author

**N66-14077#** David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
**A DIGITAL FILTER FOR SEPARATING HIGH-FREQUENCY AND LOW-FREQUENCY COMPONENTS OF A TRANSIENT SIGNAL**
Thomas L. Geers and Stewart A. Denenberg Jan. 1964 39 p refs
(DTMB-1795; AD-432277) CFSTI: $3.60

A filter is described which separates a transient signal into high- and low-frequency portions and introduces no phase shifts or amplitude changes in either portion. A program written in Fortran for an IBM 7090 computer which will filter a sampled time-history record is presented. Simple formulas are given for estimating errors in the filter that are due to sampling and truncation of the continuous record. Application of the filter to signals produced by two or more physical sources is discussed. Author (TAB)

**N66-14105*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HORIZON SENSOR: RATIO OF SIGNAL TO NOISE**
Eugene I. Mohr *In its* Goddard Summer Workshop Program [1964] 6 p ref (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The electrical noise in the thermistor bolometer, amplifier noise of the horizon sensor, total energy received by the bolometer, and signal voltages versus cloud temperatures are discussed for spacecraft equipped with television cameras and horizon sensors. It is concluded that since the signal-to-noise ratio is more than 30 to 1 for a cloud as cold as 200° K, which may on occasion be seen by the horizon sensor, it would appear safe to assume that the cutoff value of the amplifier may be set at 200° K. The signal-to-noise ratio for the pulse given by the true horizon would be well above a satisfactory level; the pulses of false horizons given by clouds would usually be above cutoff and would thus be eliminated. E.E.B.

**N66-14142#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**ELECTRIC WAVE PROPAGATION IN PERIODIC MEDIA**
Felix John Gollucci (M.S. Thesis) Aug. 1965 44 p refs
(GE/EE/65-10; AD-623082) CFSTI: HC $2.00/MF $0.50

Wave propagation and frequency dispersion characteristics are investigated for electromagnetic wave propagation in a periodic medium. The permittivity is square wave stratified about an average value along a single coordinate. The propagation characteristics for TE waves are studied through an analysis of the Hill differential equation. Transmission characteristics and an omega-beta diagram are derived from a stability chart typical in the study of a Hill equation. Experimental verification of predicted stop bands is accomplished with a standard laboratory microwave transmission system while the omega-beta diagram is experimentally verified by the well-known resonant cavity technique. Author (TAB)

**N66-14152*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LAUNCHING OF SURFACE WAVES ON AXIAL-CYLINDRICAL REACTIVE SURFACE**
Norman C. Wenger Washington, NASA, Jan. 1966 33 p refs
(NASA-TN-D-3180) CFSTI: HC $2.00/MF $0.50 CSCL 20C

The excitation of the dominant transverse magnetic (TM) surface wave on an axial-cylindrical reactive surface is discussed. The surface wave launcher consists of a perfectly conducting, infinitely thin cylindrical surface coaxial with an axial-cylindrical reactive surface. The reactive surface is of infinite extent, and the perfectly conducting surface is of semi-infinite extent. The surface wave is excited by the dominant TM mode in the coaxial portion of the structure. Numerical results are obtained for the energy transported by the reflected field, the surface wave field, and the radiation field by using an exact analysis. The exact results are then compared with the results from two approximation techniques that are frequently used to solve problems of this class to determine the validity of these techniques. This method of excitation was found to be very efficient over a large range of frequencies and over wide variations in the surface reactance. Author

N66-14196# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.

**DESIGN CURVES FOR BORESIGHT AND TRANSMISSION ANALYSIS OF SEVERAL RADOME WALL STRUCTURES**

R. E. Van Doeren 21 May 1965 51 p refs

(Contract NOw-64-0293-d)

(Rept.-1804-3; AD-623656) CFSTI: HC $3.00/MF $0.50

The qualitative relation between boresight-error characteristics of a streamlined radome and the planewave transmission properties of plane dielectric sheets and sandwiches is discussed. To minimize the boresight errors, a radome wall structure should be selected which has small values of d/d $\theta$ absolute value of T and d/d $\theta$ (IPD), where, absolute value of T is the magnitude of the transmission coefficient, (IPD) is the insertion phase delay, and O is the angle of incidence. To facilitate the preliminary design of the radome wall structure, data on absolute value of $T^2$, d/d $\theta$ aboslute value of T and d/d $\theta$ (IPD) are presented in graphical form for thin walls, half-wave walls, and sandwiches. The data cover a range of frequencies and angles of incidence. It is noted that the properties of the radome wall structures considered here are significantly better for parallel polarization than for perpendicular polarization. This suggests that a useful reduction in boresight error could be obtained by automatically controlling the polarization of the radar antenna as it scans in various directions. Author (TAB)

N66-14205# Navy Underwater Sound Lab., New London, Conn.

**THE QUASI-STATIC FIELDS OF A HORIZONTAL MAGNETIC DIPOLE**

Peter R. Bannister 1 Nov. 1965 20 p refs

(USL-698; AD-623559) CFSTI: HC $1.00/MF $0.50

The electric field components produced by a horizontal magnetic dipole are derived for the quasi-static range ($|\gamma_0\rho| << 1$) and z = h = 0. The magnetic field components which have previously been derived are included for completeness. The special cases of $|\gamma_1\rho > 1|$ and $|\gamma_1\rho < 1|$, and the effect of burying the transmitting and receiving dipoles are examined for both the electric and magnetic field components. $\gamma_0$ is the upper half space (free space) propagation constant. $\gamma_1$ is the lower half space (the earth) propagation constant. $\rho$ is the radial distance in a cylindrical coordinate system. TAB

N66-14223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**A STUDY OF THE JPL MARK I RANGING SUBSYSTEM**

S. Levine, M. L. Spafford, H. W. Shaffer, and R. T. Tagler Nov. 1965 104 p refs

(NASA-TM-X-55346; X-531-65-467) CFSTI: HC $4.00/MF $0.75 CSCL 09F

A study of the Mark I ranging subsystem was made at the Goddard Space Flight Center (GSFC). This report discusses the system in terms of locally generated flow charts which describe its operation. A brief discussion of the rf components and the spacecraft transponder (as they apply to the ranging system) is included to present a more comprehensive picture of the ranging operation. The report also contains a discussion of basic system considerations: translation equations, the derivation of the Chinese Numbers, and the correlation relationships. Author

N66-14236*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**NASA/MOTS OPTICAL OBSERVATIONS OF THE ANNA IB SATELLITE**

David W. Harris and John H. Berbert Washington, NASA, Jan. 1966 18 p refs

(NASA-TN-D-3174) CFSTI: HC $1.00/MF $0.50 CSCL 17H

The ANNA IB satellite, launched October 31, 1962, carried a set of high intensity optical beacons which were programmed to flash at predetermined times. Tracking cameras would photograph the flash sequences against the star background and obtain highly accurate positions of the spacecraft through rigorous reductions of the plates. Listed are the positions obtained by successful observations from the Minitrack Optical Tracking System (MOTS) cameras as referenced to an Equator and Equinox of 1950.0. Also listed are corrections for five "apparent place" positions. Author

N66-14276*# National Aeronautics and Space Administration, Washington, D. C.

**SATELLITE COMMUNICATIONS: SIX YEARS OF ACHIEVEMENT, 1958–1964**

1 Mar. 1965 106 p refs

(NASA-TM-X-57060) CFSTI: HC $4.00/MF $0.75 CSCL 17B

In summarizing the development of communications satellites, the objectives of the United States are reviewed, and a brief history of information communications is presented. The problems encountered in the early phases are discussed, and the research achievements which led to the successes of the passive and active satellites are recounted. The technology of communications satellites, and the significant technical questions undergoing continuing analysis are examined. The legal, economic, and political problems involved in a global system are pointed out, in context with the potential of these communications systems. A bibliography, relating to each project, is included. M.G.J.

N66-14293*# New York Univ., N. Y. Lab. for Electroscience Research.

**DISCUSSION OF TELEMETRY PERFORMANCE STANDARDS Technical Memorandum No. 40**

Leonard S. Schwartz Jun. 1964 14 p

(Contract NAS5-3508)

(NASA-CR-68979) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Standards for operation of telemetry systems are presented. It is shown that suitable performance standards are given in terms of error and rejection probabilities. The trade-off between these probabilities with signal-to-noise ratio as parameter is discussed, and a method of testing different equipments for a given policy, or of testing different policies on the same equipment is outlined. Possible application of these ideas on the S-3 vehicle data is examined. Author

N66-14318# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.

**A METHOD FOR ESTIMATING ATMOSPHERIC NOISE AMPLITUDES AND PHASE ERRORS IN QUENCHED HIGH-Q RECEIVING CIRCUITS**

E. A. Lewis Sep. 1965 41 p refs *Its* Physical Sci. Res. Papers No. 136

(AFCRL-65-678; AD-623645) CFSTI: HC $2.00/MF $0.50

Very narrow-band quenched filters used for studying VLF radio signals differ from conventional narrow-band circuits in that both signal and atmospheric noise impulses cause only brief quasi-sinusoidal outputs instead of a prolonged ringing. The random overlapping of these short noise and signal bursts can cause errors in phase measurements. It is shown that the distribution of phase errors can be calculated from the amplitude distribution of the output noise envelope. The properties

of the phase distribution are discussed in detail, the computation required in the general case is illustrated by means of a numerical example. A simple 'time-sequential' method for experimentally obtaining typical amplitude distributions is suggested. Author (TAB)

**N66-14324#** Air Force Cambridge Research Labs., Bedford, Mass. Upper Atomosphere Physics Lab.
**CHARACTERISTIC WAVE CATALOGUING FOR RAY PATH DETERMINATION**
Yuji Inoue and Samuel Horowitz Sep. 1965 31 p refs
(AFCRL-65-693; AD-623646) CFSTI: HC $2.00/MF $0.50

Wave cataloguing suitable for ray tracing of a pulsed wave packet in a weakly-dissipative, horizontally stratified magnetoionic medium is described. Particular attention is devoted to the cataloguing of the various characteristic waves so that the influence of the local ionization density and collision frequency can be understood. The procedure presented is applicable under general incident conditions and complex refractive index surfaces. The Booker quartic equation is used to derive the unambiguous wave normals and wave identification is obtained from the dispersion equation. A modified CMA diagram including collisions is illustrated. Author (TAB)

# 08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

**N66-13313#** Joint Publications Research Service, Washington, D. C.
**EVALUATION OF THE AMBIGUITY IN COMPRESSION OF WORD CODES**
K. I. Kurbakov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 131–142 refs (See N66-13301 04-10) CFSTI: $6.00

A probability model is investigated on the basis of which an evaluation of the ambiguity in the compression of word codes is given, and some results from statistical simulation are discussed. Author

**N66-13525*#** Systems Engineering Labs., Inc., Fort Lauderdale, Fla.
**NAVIGATION SYSTEM TEST STATION Final Report**
[1965] 17 p
(Contract NAS8-11584)
(NASA-CR-68712) CSCL 09B

Results of a final report on two Navigation System Test Stations are presented. The test stations are controlled by an RCA110A computer and performed test and measurement functions on several configurations of navigation systems within the Saturn Program. Each test station consists of a buffer, control, and measurement section. Functional descriptions are given for the word format, input data display, input parity check, operating modes, recorder relays, signal output relays, solid state multiplexer, relay multiplexers, level detectors, alarm circuits, break point switches, analog-to-digital converter, and typewriter. Specifications and characteristics of the system are listed. A photograph and a block diagram which illustrates the logical arrangement of the units are included. M.R.W.

**N66-13542#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency.
**PROCEEDINGS OF THE TWELFTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION**
Sep. 1965 56 p ref Meeting held at San Francisco, 7–8 Jun. 1965
(Contract NOw-62-0604-c)
(CPIA Publ.-92; AD-470281)

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2. DEVELOPMENT AND USAGE OF THE ROCKET TRAJECTORY PROGRAM B. W. Boehm (RAND Corp.) p 48–53 ref (See N66-13544 04-08)

**N66-13543** Douglas Aircraft Co., Inc., Santa Monica, Calif. Advance Defense System Directorate.
**A DISCUSSION OF THE LOGIC AND CAPABILITIES OF A FULLY AUTOMATED GENERAL MISSILE SIZING PROGRAM**
W. R. Winton *In* APL Proc. of the 12th Meeting of the ICRPG Working Group on Design Automation Sep. 1965 p 23–47 (See N66-13542 04-08)

A description is presented of an IBM 7094 digital computer program developed to perform both the sizing and the preliminary design of missile configurations to deliver a specified level of performance. The computer program, referred to as the General Missile Sizing Program, contains all of the design and analysis functions required to design a missile configuration and determine its performance. These functions include solid propellant grain, motorcase, nozzle, airframe, heat shield, and control system design; the computation of in-flight air loads, and configuration aerodynamics; and trajectory simulation and optimization. Descriptions are presented of the characteristics, applications, and advantages of the computer program and the logic, capabilities, and design options. The input requirements and output data are described. Finally, current and future program improvements are discussed. Author

**N66-13544** RAND Corp., Santa Monica, Calif.
**DEVELOPMENT AND USAGE OF THE ROCKET TRAJECTORY PROGRAM**
Barry W. Boehm *In* APL Proc. of the 12th Meeting of the ICRPG Working Group on Design Automation Sep. 1965 p 48–53 ref (See N66-13542 04-08)

Described is a digital computer program written in Fortran language that simulates trajectories of aerospace vehicles. It accepts inputs and produces outputs in the language of the engineers; can simulate the flight of multistage boosters or missiles, satellites, reentry vehicles, airplanes, or any hybrids thereof, with approximate equal facility; and provides a well defined interface between the basic program and the options available to the user. The program integrates numerically the set of differential equations of motion of the specified vehicle and automatically calculates earth gravitational and rotational effects. Besides tracing the trajectories as a function of time, the program also provides detailed information on the vehicles performance during flight. G.G.

**N66-13597#** General Precision, Inc., Binghamton, N. Y. Link Group.
**UNIVERSAL PRINT READER TECHNIQUES Final Report, 30 Jun. 1963–May 1965**

R. B. Greenly, K. K. Maass, J. W. Meyer, and S. A. Michalik
Griffiss AFB, N. Y., RADC, Oct. 1965 107 p *Its* Rept.-634
(Contract AF 30(602)-3116)
(RADC-TDR-64-374, Vol. I; AD-623613) CFSTI: HC $4.00/MF $0.75

The objective of this program was to provide engineering services directed toward standardization of typewriter fonts and related features for optical scanning application. Primary emphasis was placed on investigation and evaluation of existing typewriter fonts and includes an evaluation of a type font developed by Subcommittee X3-1 on Character Recognition under American Standards Association Sectional Committee X3-1. Investigations were by computer programmed assessment of each font using a technique developed partly under Contract AF30(602)-2642 sponsored by Rome Air Development Center (AD-404 846) and partly under continuing Link sponsored character recognition efforts. Evaluations were accomplished by extending the vocabulary capacity of a Link Multi-font Page Reader to permit machine reading of a significant volume of typewriter-prepared documents. Reject and error rates were determined in this manner for each of several type styles considered. Author (TAB)

**N66-13598#** IIT Research Inst., Chicago, Ill.
**DEVELOPMENT OF THE DETAILED PLAN FOR A RELIABILITY CENTRAL**
M. E. Goldberg, R. S. Hollitch, G. T. Jacobi, H. A. Lauffenburger, and E. S. Schwartz Griffiss AFB, N. Y., RADC, Oct. 1965 435 p
(Contract AF 30(602)-3426)
(IITRI-E-6018-3, Vol. 2; RADC-TR-65-94, Vol. 2; AD-623196) CFSTI: HC $7.35/MF $2.00

Reliability data on electronic components is essential for Air Force Systems designs, procurement, and specification review. This final report delineates the functions and methods of operation of a Reliability Central adequate to meet these requirements. It constitutes an implementation study leading in progressive steps to an operation which will perform data collection, retrieval, and analysis over a wide spectrum of electronic component parts. Diverse users of analyses both within and outside the Air Force are considered in detail. The report describes the required classes of data, a data processing system required for its acceptance, retrieval, and analysis, and provides detailed description of the proposed outputs and services. Volume One constitutes a detailed plan for the implementation of Reliability Central, together with summary descriptions of its inputs, outputs, and its relation to other groups. Volume Two contains detailed technical discussions in support of the recommended implementation plan.
Author (TAB)

**N66-13600#** Rome Air Development Center, Griffiss AFB, N. Y. Information Processing Branch.
**AN APPROACH TO AUTOMATED CONTEXTUAL CHARACTER RECOGNITION**
Charles A. Constantino, John C. Faust, and John W. Sammon, Jr. Sep. 1965 21 p refs
(RADC-TR-65-350; AD-623487) CFSTI: HC $1.00/MF $0.50

The purpose of this report is to combine current knowledge and technology to set forth an approach for designing a machine capable of recognizing various styles of typed characters. This approach differs considerably from existing approaches in that it has the capability to make use of context to aid in recognition. This is accomplished by the tabulation of the probability that one particular letter follows another letter. Hence, when attempting to recognize a typed character, the machine has knowledge of the previous letters or letter that it recognized, and can make use of this information in identifying the typed character presently being processed. Author (TAB)

**N66-13704#** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**FORTRAN IV STEREOGRAPHIC FUNCTION REPRESENTATION AND CONTOURING PROGRAM**
G. A. Mc Cue, M. M. Dworetsky, and H. J. Du Prie 1 Sep. 1965 49 p refs
(SID-65-1182)

This paper describes the use and operation of a visual data representation package which will generate stereographic drawings, stereographic contour maps, and perspective projections. This form of visual data representation significantly increases one's ability to comprehend the nature and structure of complicated functions or data arrays. The package has been programmed as a series of Fortran IV subroutines which utilize the SC-4020 as an output device. Author

**N66-13752#** Defense Dept., Washington, D. C. Office of the Director of Defense Research and Engineering.
**SURVEY OF STUDIES AND COMPUTER PROGRAMMING EFFORTS FOR RELIABILITY, MAINTAINABILITY AND SYSTEM EFFECTIVENESS**
Sep. 1965 72 p refs
(OEM-1; AD-622676) CFSTI: HC $3.00/MF $0.75

Survey of efforts under way or recently completed for computer programming or techniques that are adaptable to computer operations in the areas of system analysis for reliability, maintainability, availability, system effectiveness, cost-effectiveness, system simulation, circuit analysis, and failure mode and effects analysis. Author (TAB)

**N66-13774#** Naval Research Lab., Washington, D. C.
**PROGRAMMING IMPLICATIONS OF THE NRL AN/GYK-3(V) DISK STORAGE SYSTEM Interim Report**
R. H. Smith Sep. 1965 20 p
(NRL-MEMO-1649; AD-622284) CFSTI: HC $1.00/MF $0.25

The prototype AN/GYK-3(V) computer was equipped with a limited amount of memory; thus, it was considered necessary to increase this memory capacity in order to permit the application of this machine to future work in radio propagation for production AN/GYK-3(V)'s. The material presented here covers the programming implications of the NRL Disk Storage System. The system provides a fifteen fold increase in the on-line memory capacity as well as an unlimited increase in off-line capacity through the use of removable disk packs. The system consists of three IBM 1311 Disk File Drives and a File Control Unit (FCU) with each Disk File Drive having a capacity of 409,500 48-bit words. Read or write operations are accomplished with two modes of seek, Return to Home (RTH) and Direct, each rendering a minimum seek time under certain conditions. The average cylinder seek time is 250 ms for RTH and 150 ms for Direct. A special feature is included with this system allowing for a write check of written data without using valuable computer time. TAB

**N66-13860#** Oak Ridge National Lab., Tenn.
**CHRNOEGRM—A COMPUTER PROGRAM FOR ANALYSIS OF CHRONOPOTENTIOGRAMS**
Serena Savage and W. D. Schults 31 Aug. 1965 15 p
(Contract W-7405-ENG-26)
(ORNL-TM-1254) CFSTI: HC $1.00/MF $0.50

A computer program is given which computes the "least squares" straight line, the slope, the quarter-wave potential, and the standard deviations for the latter two parameters for the conventional semi-log (Karaoglanoff) plot of potential-time data taken from experimental chronopotentiograms. These results, plus the input data and the value of the logarithm term

in the Karaoglanoff equation, are printed out to facilitate comparison between theory and experiment. Detailed instructions for the use of the program are given. The program is written in Fortran 63 for the ORNL CDC 1604-A computer. Author (TAB)

**N66-13888#** California Univ., Los Angeles. Dept. of Engineering.
**THE LOGICAL DESIGN OF A TRANSFER PATH FOR THE VARIABLE STRUCTURE COMPUTER SYSTEM**
Donn Arthur Hopkins July 1965 148 p refs
(Contract Nonr-233(52))
(Rept.-65-16; AD-619894) CFSTI: HC $6.00/MF $1.25

The transfer path is a buffer unit that will be used to direct couple an IBM 7094 to the Variable Structure Computer. In addition to buffering, the transfer path, TP, allows the Variable Structure Computer, V, to control the rate and direction of 7094 computation. Two onecycle transfers executed by the 7094 are conditional upon information contained in V. The TP can electronically stop or start the 7094 at any time; 7094 traps may be initiated by V through the TP. A number of modifications to 7094 logic were required to obtain the desired operation; a description of these modifications has not been included in this report. Reference is made to the 7094 logic pages where TP signals are introduced. The report consists of eight chapters. Chapter I is an introduction to the Variable Structure Computer and a statement of design objectives. Chapter II describes what the TP does and how it interacts with the 7094. Chapter III is a user's manual for the TP. Chapter IV concerns data transmission rates and includes a discussion of 7094 instruction overlap. Chapters V through VIII are a description of the TP logic; the material includes a description of the logical elements, a set of sequence and timing charts, a set of logical equations, implemented logic diagrams, and a brief description of the packaging. The reader must be familiar with the 7094 logic before it is possible to understand the details of the TP logic. Author (TAB)

**N66-14045#** Oak Ridge National Lab., Tenn.
**NUMERICAL SOLUTION OF THE LAGRANGE MULTIPLIER PROBLEM WITH SEVERAL CONSTRAINTS**
Francis B. K. Kam and Francis H. S. Clark Dec. 1965 35 p
(Contract W-7405-ENG-26)
(ORNL-3846)

A generalized multiple-constraint Lagrange multiplier program has been written in Fortran for the CDC-1604 computer. The program, called XTREME, is an extension of program MAX. XTREME can deal with up to 25 independent variables. It finds an extreme value for an object function subject to a number of equality constraints, at most one less than the number of independent variables. All second derivatives of the object function and the constraining functions must exist everywhere in the domain of computation. Author

**N66-14046#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**COMPUTER TECHNOLOGY Surveys of Soviet Scientific and Technical Literature**
Joseph Podoski and Stuart Hibben 13 Oct. 1965 63 p refs Compilation of Abstracts
(ATD-P-65-64)

A compilation of abstracts is presented on computer technology. Information not directly related to the computer subject is included because of its broad implications for study in this field. The 43 abstracts are arranged alphabetically by author within each of the following categories: components, design, applications, and associated systems. C.T.C.

**N66-14068#** Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.
**A 100-NODE AUTOMATIC LIEBMANN ANALOGUE**
W. S. Buist and C. J. Rallis Aug. 1965 41 p refs Presented at the 1st Analogue Computer Symp., Witwatersrand, Johannesburg, 21 Apr. 1965
(Rept.-29)

Common methods of solving the diffusion equation are summarized, with special reference to the Liebmann analogy to the finite difference approximation of the equation. The problems of network size, solution time and real time are mentioned and the design and construction of a 100-node fully automatic Liebmann analogue computer is described. The final section describes how the new instrument is to be used for determining heat flow in mines. Other problems to which it is hoped to apply the computer are also discussed, including applications in which it may be coupled up with a digital computer. Author

**N66-14070#** Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
**PROGRAMMING, INTEGRATION, AND CHECKOUT OF THE STORED PROGRAM ALPHA-NUMERIC BEACON SYSTEM Final Report**
Jun. 1965 90 p
(Contract FA-64-WA-5020)
(RD-65-79)

Work performed under this contract includes design and preparation of the computer program for the operational system, electrical and operational integration of the system at the Air Route Traffic Control Center at Indianapolis, Indiana, and checkout of the system to verify its compliance to government specifications and requirements. All system equipments, the system site, and site furnishings were provided by the government. The major functional elements of the operational computer program are tracking, processing of controller inserted data and requests, and preparation of properly formatted messages for display. The tracking function is multistate $\alpha$, $\beta$, straight line tracking. The availability of the system's general purpose digital computer made possible an approach to equipment system integration which was primarily based upon a sequence of specially designed programed tests. Author

**N66-14074*#** Stanford Univ., Palo Alto, Calif. School of Medicine.
**DENTRAL-64: A SYSTEM FOR COMPUTER CONSTRUCTION, ENUMERATION AND NOTATION OF ORGANIC MOLECULES AS TREE STRUCTURES AND CYCLIC GRAPHS. PART II: TOPOLOGY OF CYCLIC GRAPHS Interim Report**
Joshua Lederberg 15 Dec. 1965 74 p refs
(Grant NsG-81-60)
(NASA-CR-68898) CFSTI: HC $3.00/MF $0.75 CSCL 09B

An analysis of cyclic graphs to allow the enumeration of the ring structures of chemistry is discussed. Areas that were studied are: a general introduction to the treatment of rings; the trivalent cyclic graphs; numbering of vertices and edges; quadrivalent vertices; planar mesh representations; further developments in the theory of trivalent graphs; symmetry classification—general systematics of graphs; coding and reconstruction of a Hamilton circuit; and algorithm for finding Hamilton circuits of a cyclic graph. R.W.H.

**N66-14075*#** Stanford Univ., Palo Alto, Calif. School of Medicine.
**SYSTEMATICS OF ORGANIC MOLECULES, GRAPH TOPOLOGY AND HAMILTON CIRCUITS. A GENERAL OUTLINE OF THE DENDRAL SYSTEM Interim Report**

Joshua Lederberg 12 Jan. 1966 37 p refs *Its* Tech. Rept.-1040
(Grant NsG-81-60)
(NASA-CR-68899) CFSTI: HC $2.00/MF $0.50 CSCL 09B

Some elementary features of graphs that may be used for a systematic outline of organic chemistry are reviewed. The main approach used is mapping, a rule of correspondence between a part of the chemical structure and a part of some abstract graph. It was stated that each atom may be mapped on to a node: each bond to an edge or link of the graph. It was noted that for further analysis, it will be important to map from complexes of the structure to elements of a graph. R.W.H.

N66-14164# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
**THE FLIC CONVERSION CODES**
J. C. Basher May 1965 38 p refs
(AEEW-R-439) HMSO: 5s 6d

This report describes the Fortran programmes, FLIC 1 and FLIC 2. These programmes convert programmes coded in one dialect of Fortran to another dialect of the same language. FLIC 1 is a general pattern recognition and replacement programme whereas FLIC 2 contains extensions directed towards the conversion of Fortran II and S2 programmes to Egtran 1—the dialect now in use on the Winfrith KDF9. FII or S2 statements are replaced where possible by their E1 equivalents; other statements which may need changing are flagged. Author

N66-14184# Princeton Univ., N. J. Dept. of Psychology.
**SOME IBM 7090-94 PROGRAMS FOR NONLINEAR FACTOR ANALYSIS**
Roderick P. Mc Donald Aug. 1965 56 p refs
(Contract Nonr 1858-(15); Grants NSF-G-22889; NSF GP-579)
(RM-65-11; AD-623205) CFSTI: HC $3.00/MF $0.50

The programs described were written for use within the content of a theory of nonlinear factor analysis developed by McDonald. In this context, three of the programs, SPAN, POSER, and FAINT, expect as input the results of a series of standard factor analysis operations. In particular, the input formats are chosen to conform to the PUNCH format from PSTAT. The fourth program, COPE, expects as input the punched output from either SPAN or POSER, and some punched output as available from PSTAT. In their present form, then, the programs communicate with each other via punched cards. With suitable modifications this could be done via tape. Author (TAB)

N66-14193# Case Inst. of Tech., Cleveland, Ohio. Systems Research Center.
**ADAPTIVE PATTERN RECOGNITION USING NON-LINEAR ELEMENTS**
Anthony N. Mucciardi (M.S. Thesis) Oct. 1964 133 p refs
(Grants AF-AFOSR-125-64; AF-AFOSR-751-65; NSF GP-642)
(SRC-65-A-64-22; AD-623215)

A pattern recognition device which computes a weighted sum of all products of its binary input variables is investigated. It is proven that this device can uniquely synthesize any real function of its inputs. The size of this device becomes prohibitive as the number of inputs increases and the concept of an incomplete device is introduced and discussed. A convergence proof of an adaptive training procedure for real outputs, based on the equivalence between this device and a multi-threshold linear device in a larger input space, is presented. A set of orthogonal property detectors is defined and shown to be numerically equal to the number of binary inputs. A computer simulation of a 64-input incomplete device shows that its generalizing abilities are more fully utilized with the aid of specific property detectors. A self-organizing technique consisting of periodically discarding low-weighted terms and replacing them with randomly chosen terms is discussed. Experiments conducted using this technique demonstrate that the learning and generalizing performances of the incomplete device are greatly improved if the device is free to change its structure according to a heuristic policy. Author (TAB)

N66-14214# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
**AUTOMATIC MEASUREMENTS FOR ELECTRONIC CIRCUITS [AUSDRUCKVERFAHREN FUR ELEKTRONISCHE IMPULSZAHLER]**
W. Attwenger and K. Petreczek Mar. 1965 22 p refs In GERMAN; ENGLISH summary
(SGAE-E-4/1965) CFSTI: HC $1.00/MF $0.50

Scalers with printout units are used for automatic measurements in nuclear research. An electronic circuit is described which allows the print-out of collected datas of one or more scalers. The printer is a common adding machine. Author

N66-14247*# Maryland Univ., College Park. Computer Science Center.
**FORTRAN II TO FORTRAN IV TRANSLATOR UOM SFT FOR THE IBM 7090/7094**
Donald E. Eastlake, III Nov. 1965 38 p
(Grant NsG-398)
(NASA-CR-68462; TR-65-25) CFSTI: HC $2.00/MF $0.50 CSCL 09B

This report describes a program (UOM SFT) written in Snobol for the IBM 7090/7094 for the translation of Fortran II into Fortran IV. The use of the basic translator and also of its many special features is described in detail. A number of examples such as deck setup, control card format, and one complete sample Fortran II deck and its translation are included. UOM SFT is also compared with SHARE SFT, a translator written in machine language. Author

N66-14323# Joint Publications Research Service, Washington, D. C.
**LEXICAL MEMORY UNIT FOR AN ELECTRONIC DIGITAL COMPUTER**
L. V. Kulakov 2 Nov. 1965 8 p refs Transl. into ENGLISH from Nauchno-Tekhn. Inform. (Moscow), no. 6, 1965 p 20-22
(JPRS-32676; TT-65-33155) CFSTI: $1.00

A continually associative storing device is proposed for use as the English-Russian lexicon of an informational logic computer. When fed with a literally coded English word, the unit puts out the code of the corresponding Russian word. A block diagram of the unit and a short description of its memory structure are presented, and the means of joining two different types of memory units which make up the unit, into a whole without any sort of intermediate elements are examined. In result the code's output impulses could be set up through the energy of the input code impulses, which are transformed in the memory with a high degree of efficiency. Certain structural principles of the unit are discussed. Author

# 09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

**N66-13350*#** Microwave Physics Corp., Garland, Tex.
**THE DEVELOPMENT OF AN S-BAND PARAMETRIC AMPLIFIER USING NEW TECHNIQUES FOR GAIN STABILIZATION Final Report**
Nov. 1965 26 p refs
(Contract NAS8-11817)
(NASA-CR-68605) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This report describes the results of a research and development program investigating parametric amplifier gain stabilization using temperature sensing and compensation techniques. The work included development, testing, and delivery of an operating laboratory model of an S-band amplifier tuned to 2.276 Gc. This amplifier should have a wide variety of applications in communications or tracking systems in which temperature changes are sensed and corrected for, thus eliminating the requirement for a controlled environment. Author

**N66-13363*#** Research Triangle Inst., Durham, N. C. Solid State Lab.
**FEASIBILITY STUDY OF PIEZOTRANSISTOR ACCELEROMETERS Annual Report**
Sep. 1965 179 p refs
(Contract NASr-222)
(NASA-CR-68593) CFSTI: HC $5.00/MF $1.00 CSCL 09A

The feasibility of using p-n junction devices as a transducer for accelerometers was examined. The effects of mechanical strain on Ge and Si semiconductor parameters associated with p-n junctions were studied. Silicon diodes, transistors, and 4-region devices were tested by observing their electrical characteristics under mechanical stress. A theoretical model based on the distortion of the energy band structure of a semiconductor under stress was developed. Analytical expressions were developed describing the p-n junction devices characteristics under stress. The model agreed well with experimental results. Stress was found to lower the electrical resistance of single junction devices, lower the gain of transistors, and lower the breakdown voltage of 4-layer diodes. Accelerometers were tested using the silicon needle approach to p-n junction transducers. These tests showed that it is feasible to use the piezojunction effect in semiconductors as the transducer in accelerometers. It was concluded that p-n junction devices can be used in a variety of transducer applications. Any physical phenomenon resulting in mechanical force and displacement can theoretically be detected by p-n junction devices if the force is on the order $10^3$ dynes or larger. R.N.A.

**N66-13445#** Melpar, Inc., Falls Church, Va.
**INVESTIGATION FOR 2000° F POWER WIRE Quarterly Report, 21 Jun.–20 Sep. 1965**
[1965] 51 p refs
(Contract AF 33(615)-2721)
(QR-1; AD-472102)

High purity rhodium conductor materials have been procured in wire form. Various high-temperature dielectric materials have been obtained and are being tested for use as bulk insulation in the 2000° F power wire system. A literature search on high temperature dielectrics has been completed. Work has been initiated on the pyrolytic deposition of $SiO_2$ and BN, as film type dielectrics, directly on the rhodium wire. A preliminary investigation was made of a bulk insulation system utilizing ceramic beads and silica fiber sleeving. Terminal designs have been made. Author (TAB)

**N66-13448#** Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
**RESEARCH ON OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report No. 2**
J. R. Biard Oct. 1965 41 p refs
(Contract AF 33(615)-2643)
(Rept.-03-65-111; AD-473357)

Application of optoelectronics to Functional Electronic Blocks (FEB's) is being investigated to perform functions requiring integrated arrays of solid-state light sources optically coupled to arrays of detector circuits. Task I concerns design and fabrication of optoelectronic FEB's; Task II supports Task I through optical and electrical investigations and experiments required to provide necessary technology and design data. Task I—A commutator array and a read-only memory array have been selected for study. Processing techniques were developed which resulted in the successful fabrication of the commutator light source array. Detector array work has centered on the fabrication of the double-emitter transistors. The initial success with oxide-isolation for the read-only memory light source array has been repeated, and the first measurements were made of quantum efficiency and coupling characteristics. Task II—Material investigations have been conducted with GaAsP and GaP toward improving external quantum efficiency and achieving shorter wavelength emission. Diffusion and transmission experiments have also been conducted. Improvements have been made in the optical microprobe equipment, and a considerable quantity of data has been taken on a variety of samples. The transient behavior of a p–n junction with two-carrier injection has been studied with computer analysis of an electrical analog. Author (TAB)

**N66-13463#** Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
**MATERIAL PROCESSING AND PHENOMENA INVESTIGATIONS FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Technical Report, 10 May–15 Sep. 1965**
J. W. Thornhill [1965] 55 p
(Contract AF 33(615)-3095)
(ITR-1; AD-473801)

The electrochemical work is proceeding in three main areas, anodic deposition of boron doped oxides, electrophoretic deposition of impurities onto silicon and selective oxide etching induced by irradiation. The work on anodic deposition of boron doped oxides has mainly involved the investigation of the use of pyrolytically deposited silicon oxide overlayers to prevent the loss of boron from doped oxides. Investigations on techniques for electrophoretic deposition of boron compounds are in progress. Boric anhydride in nitroethane has been found to be a suitable medium. A series of experiments have been performed to investigate reproducibility of doping levels and the effects of various parameters. The effect of electron and proton bombardment on the etch rate of silicon dioxide has been investigated. Author

**N66-13469#** Radio Corp. of America, Camden, N. J. Communications Systems Div.
**MICROMODULE PROGRAM Final Report**
Jul. 1965 84 p
(Contract DA-36-039-SC-75968)
(AD-468679)

The Micromodule Program provided for the implementation of an equipment miniature packaging technique utilizing a 3-dimensional stacking of wafer-type elements. These elements, called microelements, are designed to a new and common geometry; active and passive units are either mounted on 0.310 × 0.310 inch wafers or manufactured to these dimensions. The microelements are stacked with an average

spacing of approximately 0.010 inch to form the Micromodule. The program entailed repackaging of state-of-the-art components, establishing reliability of these microelements, developing a process to stack and interconnect these microelements into a module, and establishing the reliability of the completed module assembly. Outstanding features of this micromodule packaging concept include the ability to accommodate a wide variety of circuit types and configurations in a single basic structure and its compatibility with all known circuit packaging, concepts including the advanced thin film and semiconductor integrated techniques.

Author (TAB)

**N66-13577#** General Telephone and Electronics Labs., Inc., Bayside, N. Y.

**SEMICONDUCTOR MICROWAVE AMPLITUDE AND PHASE MODULATOR Ninth Quarterly Report, 16 May–15 Aug. 1965**

R. Harrison, J. Zucker, F. Drago, D. Fieri, and R. Socci [1965] 18 p

(Contract DA-36-039-AMC-02284(E))

(TR-65-103.9; AD-623324) CFSTI: HC $1.00/MF $0.50

The drive power required to maintain a constant modulation index as the rf carrier power was varied from 0.22 mW to 2.5 mW was experimentally determined for the PIN amplitude modulator. A linear relation was found to exist between the modulation drive and the rf carrier power levels. Effort to stabilize the varactors for the phase modulator by coating the semiconductor surface with a thin dielectric film was continued. Ciba Araldite 6005 epoxy has been found to be effective in enhancing varactor stability. Experiments to encapsulate the varactor in an inert atmosphere with mylar windows or dielectric plugs were initiated. Theoretical analysis indicates that the voltage-dependent resistance of a properly biased PIN diode can be used to achieve phase modulation consistent with the program requirements. Author (TAB)

**N66-13587#** Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

**MATERIAL PROCESSING AND PHENOMENA INVESTIGATIONS FOR FUNCTIONAL ELECTRONIC BLOCKS Sixth Interim Engineering Report, 6 Dec. 1963–6 Mar. 1964**

I. M. Mackintosh [1964] 20 p

(Contract (AF 33(657)-9897)

(AD-600355)

Tracer experiments with $P^{32}$ tagged diethylphosphate have clarified several important aspects of the preparation of controlled doped anodic oxides for producing $N^+$-on-P diodes. Among the factors investigated were the reproducibility of the anodic oxide source, the correlation between the concentration of the doping electrolyte and the concentration in the anodic oxide, the effect of pure silicon dioxide coatings in preventing losses of phosphorous from the oxide source during diffusion, and the segregation coefficient at the $SiO_2$–Si interface. Also, it was found that silicon planar transistors examined in the scanning electron microscope exhibited a drop in voltage gain after such an examination. Studies were made of this effect and the data obtained indicated that the beta of the transistor falls off as a function of the electronic charge introduced by the bombarding beam. Transistor junctions subjected to the electron bombardment of the beam also show a rise in the reverse leakage current. E.E.B.

**N66-13615#** Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.

**PRODUCTION ENGINEERING MEASURE (PEM) FOR SILICON MIXER DIODE Quarterly Progress Report, 29 Mar.–30 Jun. 1965**

Garrett D. Bowne and Robert Bayliss [1965] 67 p

(Contract DA-36-039-AMC-06159(E))

(QPR-1; AD-619664) CFSTI: HC $3.00/MF $0.75

The First Engineering Test Sample Run has been completed and the devices processed through the screening and Group A testing cycle. Sample units have been started through the Group B environmental testing. A new package design has been evolved for improved hermeticity; this consists of a beryllium oxide body with brazed metal end pieces. Piece parts to the new design have been ordered for the Second Engineering Test Sample Run. Author (TAB)

**N66-13670#** Sandia Corp., Albuquerque, N. Mex.

**SOME TEMPERATURE CONSIDERATIONS IN TRANSISTOR CIRCUIT DESIGN**

D. L. Espenshade Aug. 1965 28 p refs

(Contract AT(29-1)-789)

(SC-TM-65-359) CFSTI: HC $2.00/MF $0.50

Transistor heating is analyzed to derive algebraic relations which assure satisfactory temperature equilibrium in transistor circuits. Two rather simple relations are adequate for circuits in which the transistor power dissipation is maintained below the rated maximum. The procedure for analyzing circuits in which the dissipation exceeds the rated maximum for short-time durations is explained. Several sample circuits are analyzed to derive relations describing bias and stability conditions. These relations are applicable, or can be easily modified to apply, to nearly all biasing schemes. Author (NSA)

**N66-13675#** Sandia Corp., Albuquerque, N. Mex.

**THE U1627 (A G-SECOND INTEGRATOR)**

V. Sirwinski Aug. 1965 19 p

(Contract AT(29-1)-789)

(SC-DR-65-261) CFSTI: HC $1.00/MF $0.50

The mechanical and electrical characteristics of the U1627, which is capable of integrating any shaped volt-second curve and providing a digital readout is described. Author (NSA)

**N66-13683#** Erie Technological Products, Inc., Pa.

**PRODUCTION ENGINEERING MEASURE FOR RESISTOR-CAPACITOR MICROELEMENTS FOR MICROMODULES Quarterly Report, Mar. 27–Jun. 25, 1965**

J. E. Schupp [1965] 18 p

(Contract DA-36-039-AMC-01479(E))

(QR-8; AD-622984) CFSTI: HC $1.00/MF $0.50

Progress is reported to establish capability to manufacture resistor-capacitor combination microelements for micromodules, including actual fabrication and testing of preproduction samples, and accomplishment of production type run to demonstrate mass production techniques and facilities. Author (TAB)

**N66-13684#** Texas Instruments, Inc., Dallas.

**PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 4, 31 Mar.–30 Jun. 1965**

C. L. White, K. B. Landress, and Chung M. Chang [1965] 35 p refs

(Contract DA-36-039-AMC-03632(E))

(TI-03-65-76; AD-622982) CFSTI: HC $2.00/MF $0.50

The measured value of 1.5 Gc and 3.0 Gc noise figure of the common-emitter mounted L-78B device, after correction for the second stage noise contribution, is 3.4 db and 4.9 db, respectively. All other measured parameters of the L-78B device meet the tentative electrical specifications. The newest pattern, the L-148, designed specifically to yield a device with

greater power gain capability, met all of the device parameter specifications. Typical values of the common-emitter insertion gain of the L-148 device at 1.5 Gc and 3.0 Gc and 8.5 db and 5.2 db, respectively. The corrected value of noise figure at 1.5 Gc and 3.0 Gc is 3.7 db and 5.5 db, respectively. The electrical characteristics of the L-148 device are consistent with the design modification and represent an improvement in device performance over the L-78B, especially in the area of power gain capabilities. However, since only a limited amount of devices have been obtained using the L-148 pattern, the repeatability of the process remains to be established. Until the repeatability is determined, the L-148 process is considered to be in an optimization stage. The TI-Line package has been modified by increasing the diameter of the welding flange to afford greater welding area. The modification was necessary in order to prevent the package from becoming non-hermetic after the soldering heat test. Author (TAB)

**N66-13695#** Fairchild Semiconductor Corp., Mountain View, Calif.
**PRODUCTION ENGINEERING MEASURE FOR IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY FOR PNP INTERMEDIATE POWER SILICON PLANAR SWITCHING TRANSISTORS INCLUDING 2N3502 Quarterly Progress Report, 1 Apr.–30 Jun. 1965**
W. Mc Keown, N. Walker, D. Floyd, and G. Potts [1965] 35 p
(Contract DA-36-039-AMC-06155(E))
(QPR-2; AD-622821) CFSTI: HC $2.00/MF $0.50

The report describes the primary experiments on the deposition of an $SiO_2$ layer in a horizontal epitaxial reactor and indicates the parameters affecting the uniformity of growth rate along the deposition boat. Work on the semiautomatic line was performed as scheduled. Completion of design was followed by installation of the entire system. A precise correlation between sheet resistance (V/I) and $\beta$ distribution was established and used as a tool in further development. Temperature gradient across a wafer during predeposition operations was found to be the most significant cause of $\beta$ variation. Wafers processed in flat position have shown the least amount of $\beta$ variation. TAB

**N66-13696#** Zenith Radio Research Corp., Menlo Park, Calif.
**TRANSVERSE-WAVE HIGH-POWER TUBE Quarterly Report, 1 Apr.–30 Jun. 1965**
C. Burton Crumly and Roy A. Larsen Jul. 1965 41 p refs
(Contract DA-28-043-AMC-01268(E))
(ECOM-01268-1; AD-622574) CFSTI: HC $2.00/MF $0.50

Research and development work has begun on a novel type of traveling-wave power amplifier tube, employing transverse-wave interaction between the negative synchronous wave and a circuit wave on a balanced structure. The theoretical advantage in this arrangment is the possibility of high-power amplification with high overall efficiency, due to the lack of longitudinal or transverse velocity modulation in the spent beam. No d-c pumping process is involved, so that such a tube would be free from noiseorbit pumping or beam blowup, such as occurs in the Larmotron and the Bass tube. Theoretical and experimental work on a scale model of a twisted, finned, ridged, circular waveguide has shown that an appropriate dispersion curve, as well as adequate interaction impedance, can be obtained at S-band. Design work is continuing with the objective of demonstrating the feasibility of a 1-kw CW output power, at an efficiency of at least 60%, using a depressed collector. Author (TAB)

**N66-13796#** Army Electronics Labs., Fort Monmouth, N. J.
**MODIFICATION OF TEST SET, CRYSTAL UNIT, QUARTZ TS-710/TSM**
Charles L. Shibla Jul. 1965 38 p
(ECOM-2618; AD-622778) CFSTI: HC $2.00/MF $0.50

A modification to Test Set, Crystal Unit, Quartz TS710/TSM is described. The modification is comprised of revisions in several circuit areas with a resultant improvement in operation. Overdrive of low-resistance crystals is minimized, crystal power is more accurately and conveniently measured, and frequency/resistance calibration with any standard military crystal unit is possible. Author (TAB)

**N66-13801#** Radio Corp. of America, Somerville, N. J. Commercial Receiving Tube and Semiconductor Div.
**A FIVE WATT NUVISTOR TRIODE Final Development Report, 24 Jun. 1963–24 Mar. 1965**
R. K. Reusch [1965] 146 p refs
(Contract NObsr-81478)
(AD-620917) CFSTI: HC $4.00/MF $1.00

The report covers the design and development of two nuvistor triodes having a plate dissipation capability of 5–6 watts. The two developmental types are identical in electrical characteristics but differ in envelope and terminal construction. One version, the A15512A, has a coaxial cathode terminal and the other, the A15526, has a leaded base similar to conventional nuvistors. Both types are designed for application on pulsed or cw Class C amplifiers, oscillators, or frequency multipliers at frequencies up to 1.2 Gc/s. Power output of a cw amplifier at 1.2 Gc/s with a plate input of 10 watts is about 4.4 watts. Under pulsed amplifier operation at 1.0 Gc/s, 0.025 duty factor, 5 micro sec. pulse duration, and 4.8 watts average plate input power, the peak output power is about 105 watts. Both types have an amplification factor of 100 and a transconductance of 19,000 micro mhos at a plate voltage of 200 volts, a plate current of 15.5 ma., and a cathode resistance of 68 ohms. It is believed that both types, the A15512A and the A15526, have met the objective specifications of the contract. Author (TAB)

**N66-13805#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**AN INVESTIGATION OF GERMANIUM DIODES OF VARIOUS GEOMETRIES AS INFRARED MODULATORS**
Roy Lee Oldham (M.S. Thesis) Aug. 1965 51 p refs
(GE/EE/65-17; AD-622990) CFSTI: HC $3.00/MF $0.50

Four different designs of germanium diodes were investigated to determine their capabilities to be used as infrared modulators. Only the rectangular design is capable of modulating at any usable frequency. The remaining diodes exhibit low frequency characteristics and are quite susceptible to device operating temperatures. Reasons for these results are presented and discussed. A new design is proposed which incorporates the features of a large injection area and an optical path parallel to the p–n junction. Author (TAB)

**N66-13811#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**AN EXPERIMENTAL CURRENT-PROBE SYSTEM FOR MEASURING CONDUCTED RADIO-FREQUENCY INTERFERENCE FROM 20 KC TO 80 MC Final Report, Jan. 1960–Mar. 1965**
J. L. Brooks Oct. 1965 39 p refs
(TR-R-405; AD-622556) CFSTI: HC $2.00/MF $0.50

New and improved techniques and circuits based on newly developed instrumentation have been devised for adequately performing conducted radio-frequency-interference (RFI) acceptance and compatibility tests on electrical equipment. Tests made to military specifications which have been used in the past as guides for this type of testing have been found to

be inadequate for determining the compatibility of tested equipment with electromagnetically sensitive equipment connected to the same power circuit or interconnected in a common system. The new development, based on the current probe technique and involving measurements of noise source impedances, load impedances, and noise currents, now enables one to specify completely in terms of the fundamental units of power the conducted RFI characteristics of the device under test. An impedance and phase meter was designed which covers the frequency range of 20 kc to 80 Mc and an impedance range of 10 to 10,000 ohms at 0 to 360 degrees. Functional utilization of the new techniques will require that applicable performance requirements be incorporated into appropriate military specifications. More explicit acceptability limits may now be specified. Recommended revisions are defined. An evaluation of the hardware developed is presented as well as examples of RFI measurements. Complete circuit diagrams are provided. Author (TAB)

**N66-13822#** Army Electronics Labs., Fort Monmouth, N. J.
**PULSED NUCLEAR RADIATION EFFECTS ON RESISTORS AND CABLES, SPRF IV**
Charles P. Lascaro, William Schlosser, and Joseph Newberg Dec. 1964 35 p refs
(ECOM-2545; AD-622974) CFSTI: HC $2.00/MF $0.50

Various cable and resistor types and an operating micromodule multivibrator circuit were exposed to a pulsed nuclear radiation environment (SPRF) and their transient response measured during the pulse. The initial RG-59 B/U cable response was determined to be voltage dependent and averaged 0.15 microamps per volt superimposed on a zero voltage 'replacement' current of −15 microamps. A miniature low noise cable, with conductive interfaces, gave the lowest and most stable response of all cables tested. The attenuation of three different types of RF cables was measured and the signal in JT-205 with foamed polyethylene was attenuated approximately 20%. The US-DEV −15 cable with perforated tape teflon averaged 0.3% and for RG-8 A/U, a solid polyethylene dielectric, attenuation averaged 0.5%. Carbon composition, deposited carbon film, nichrome film, tin oxide, wirewound, cermet, and gas-filled 'Minuteman' resistors of various wattages were tested in an unpotted, conformally coated, and potted condition. All low value resistors tested (less than 1500 ohms) maintained tolerance levels even in unpotted conditions. For the unpotted higher-value resistors (10 K ohm) the shunting effect of the ionized air may cause a resistance change of the order of 2% which can be reduced to 1% by conformal coating. The 100 K ohm 'Minuteman' gas-filled resistor showed an effective decrease of 7% during exposure. Author (TAB)

**N66-13825#** International Rectifier Corp., El Segundo, Calif.
**HIGH VOLTAGE SILICON RECTIFIER STACKS Quarterly Progress Report, 25 Dec. 1964–25 Mar. 1965**
A. Conn [1965] 13 p
(Contract DA-36-039-SC-85977)
(QPR-15; AD-619524) CFSTI: HC $1.00/MF $0.50

It was shown that repeated cycling between 25° C and 125° C caused seemingly random failures (dielectric leakage) among the first 75 tanks. However, it was also shown that tanks which show no increase of dielectric leakage after one temperature cycle, or those which stabilize at a fixed value of dielectric leakage do not show a further increase with repetition of cycling. An extensive investigation into the compatibility of Askarel with various types of gasketing materials was instigated since it was found that the gasket material (nitrile rubber and cork) used did lower the resistivity of the Askarel. A further investigation was made of the compatibility of the internal materials of the tank with Askarel. It was found that almost any material lowered the resistivity of the Askarel. Calculations show that if the dielectric oil has the minimum acceptable (Manufacturer's Specification) volume resistivity, the unit would fail the hi-pot test. This means that no contamination can be allowed whatsoever. Author (TAB)

**N66-13832*#** Microwave Electronics Corp., Palo Alto, Calif.
**INVESTIGATION OF SOLID STATE TRAVELING-WAVE-AMPLIFIER TECHNIQUES FOR FUTURE SATELLITE APPLICATIONS Quarterly Progress Report No. 4, 1 Mar.–30 Jun. 1965**
V. R. Johnson and F. A. Olson Jul. 1965 40 p ref
(Contract NAS5-3972)
(NASA-CR-68843) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The main program efforts during the period covered by this report were devoted to developing and improving techniques for fabricating and testing acoustic amplifier crystals. An important aspect of the tests was the observation of amplification in a CdS crystal. A computer was programmed to give theoretical data on the gain and efficiency characteristics for several acoustic amplifier crystals of interest to this program. These data are being used to guide design considerations. For the first time in this research, transducers of acceptable characteristics were evaporated onto an acoustic-amplifier crystal. This has made the authors very optimistic about the amplifier-fabrication techniques presently being used. The present state-of-the-art techniques now available to this program establish a definite base for acquiring considerable experimental data on acoustic-amplifier properties. Author

**N66-13948#** California Univ., Livermore. Lawrence Radiation Lab.
**HIGH-SPEED MICROWAVE PHASE SHIFTERS USING VARACTOR DIODES**
A. L. Gardner and Ronald S. Hawke 24 Jul. 1964 15 p refs
(Contract W-7405-ENG-48)
(UCRL-7753)

A reflection-type microwave phase shifter is described which employs the voltage-variable capacitance of varactor diodes as the adjustable element. The pill-type diodes tune their associated circuit through a resonance to produce phase shifts of over 90 degrees. With proper adjustment of the coupling—a simple procedure—the output amplitude is made essentially constant. The use of two diodes in RF series bucking configuration permits higher-power operation, although the unit is essentially a low-power device. Author

**N66-13951#** Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.
**MICROBONDS FOR HYBRID MICROCIRCUITS Fourth Quarterly Report, 1 Nov. 1964–31 Jan. 1965**
R. J. Green and S. L. Rogers [1965] 85 p refs *Its* Rept.-4
(Contract DA-36-039-AMC-03742(E))
(HSER-3111; AD-623284) CFSTI: HC $3.00/MF $0.75

A statistical analysis of the reproducibility of microbonds between gold wire and Au/Cr films on a variety of substrates are presented. These bonding material combinations have been demonstrated to produce high strength with conductors of 0.0007, 0.002 and 0.005 inch diameter gold wires where the total film thickness exceeds 15,000 A. The effects of substrate materials have been shown to be secondary unless the substrate material is sensitive to thermal shock. Microbonds between gold wire and aluminum films on alumina, glass, silicon or oxidised silicon substrates are not compatible with split tip welding. Details of test and evaluation programs on these microbonds are presented. Thermal aging studies on a

variety of microbonds are discussed. Thermal aging of the gold to gold systems showed insignificant changes in bond resistance until diffusion and/or oxidation at the higher temperatures prevented further test readings. Bonds between gold and aluminum films deteriorated rapidly at aging temperatures as low as 125C. The factual data also includes a discussion of the effects of thermal shock on a number of microbonds. Author (TAB)

**N66-13971#** Texas Instruments, Inc., Dallas. Apparatus Div.
**DEVELOPMENT OF $K_u$-BAND DUAL-CHANNEL PARAMETRIC AMPLIFIER Final Report, 15 Dec. 1964–15 Jun. 1965**
W. E. Wells, Jr. and J. C. Sadler [1965] 36 p refs *Its* Rept.-1
(Contract DA-28-043-AMC-00439(E))
(UI-60990-1; AD-623417) CFSTI: HC $2.00/MF $0.50

The modification is described of an existing $K_u$ band nondegenerate parametric amplifier and construction of a dual-channel system, complete with power supply. The final product displayed 40-mc bandwidth and 20-db gain at 16.5 Gc ± 50 mc. The two channels had noise figures less than 2.7 db and 3.2 db respectively. An evaluation of several types of varactors led to the selection of a Schottky barrier varactor as the active element. Extending the Schottky barrier technique to parametric amplifier varactors has yielded a new means of obtaining very low noise microwave amplification and high pump efficiency. A breadboard amplifier was operated with a noise figure of 2.2 db (less circulator) and required 10 mw of pump power at 40 Gc. It had a bandwidth of 65 mc at 20-db gain and was electronically tunable over 900 mc. Author (TAB)

**N66-14005#** Rosemount Engineering Co., Minneapolis, Minn. Air Data Sensor Dept.
**DEVELOPMENT OF A DEICED, FAST RESPONSE, DUAL ELEMENT TOTAL TEMPERATURE SENSOR Technical Report, Feb. 1951–Nov. 1963**
Wendell Malin, Jon Davison, and Cornelius Krollman Wright-Patterson AFB, Ohio, Res. and Technol. Div., Aug. 1965 26 p
(Contract AF 33(600)-42754)
(REC-5644A; SEG-TR-65-36; AD-622247) CFSTI: HC $2.00/MF $0.50

The purpose of the project was to design, develop, test, and furnish five (5) deiced, fast response, dual element total temperature sensors. Five (5) such sensors, REC Model 102CK2AY, were furnished to the USAF. The sensor design and development consisted of: (1) The design and development of a fast response, dual temperature sensing element. (2) The modification of the REC Model 102 deiced sensor housing to accept the dual element assembly and to increase the strut length to 4.5 inches. (3) The testing of the deiced, dual element total temperature sensor. The Model 102CK2AY total temperature sensor meets all of the requirements of specifications MIL-P-25726B and MIL-P-27723A, as applicable, and has a time constant of less than 0.3 seconds. The sensor is capable of accurately sensing temperatures when the sensor is subjected to a wind tunnel icing test at an indicated airspeed of 325 ± 25 knots, temperature of −30 ± 5C, and liquid water content of 1.25 ± .25 grams per cubic meter. Author (TAB)

**N66-14017#** Harry Diamond Labs., Washington, D. C.
**TM RESEARCH PROGRAM: HIGH-G TESTS OF COMPONENTS**
Neil D. Wilkin 1 Jul. 1965 22 p refs
(HDL-TM-65-33; AD-622405) CFSTI: HC $1.00/MF $0.50

The report covers one portion of continuing research to determine performance capabilities of various telemetry components and subsystems under high accelaration. Tests were made to obtain data on the behavior of silver and nickel-cadmium cells, gas breakdown diodes, and associated equipment needed in developing more efficient telemetry systems. Data obtained during lead-impact tests indicate that the cells can survive gun-launch accelerations up to 60,000 g and operate during an 8-min period after firing. The diodes and a high-frequency power transistor show survival capability without internal potting. The rate of failure of vinyl-covered electrical leads makes their use questionable. Techniques are recommended for making further tests of TM components and subsystems. Author (TAB)

**N66-14176#** Navy Underwater Sound Lab., New London, Conn.
**A LINEAR-TO-LOGARITHMIC CONVERTER**
Jerome J. Sheehy 16 Aug. 1965 9 p
(USL-680; AD-619674) CFSTI: HC $1.00/MF $0.50

The report describes a device which will convert a voltage level into an equivalent decibel level with respect to some reference voltage. The output is calibrated in decibels and is accurate to ±0.5 db over a 50-db range. The input voltage varies from 0.02 to 6 volts and the output is read on a digital voltmeter with 0.01 volt equal to 1 db. Author (TAB)

**N66-14185#** Purdue Univ., Lafayette, Ind. Dept. of Physics.
**SEMICONDUCTOR RESEARCH Semiannual Report, 1 Apr.–30 Sep. 1965**
C. S. Kumar et al [1965] 55 p refs
(Contract DA-31-124-ARO(D)-17)
(AD-623397) CFSTI: HC $3.00/MF $0.50

Contents: Electroluminescence Spikes in p-type GaSb; Ultrasonic amplification and intrinsic breakdown in InSb; Lithium diffusion and heat treatment of tellurium-doped n-GaSb; Weak field magnetoresistance in n-type aluminum antimonide; Transport measurements at moderate uniaxial and hydrostatic stresses, low temperatures, and large magnetic fields; Effect of stress on the resistivity and Hall coefficient of aluminum antimonide; Effect of stress on the electrical properties of n-type GaAs; Effect of pressure on the electrical properties of n-type silicon containing sulfur; Magnetoresistance of hop conduction in Ge; Excitation spectra of Group-V donors in silicon; Excitation spectra of donors in silicon-germanium alloys; Optical absorption of ZnTe; Electron paramagnetic resonance in electron irradiated germanium; Electron paramagnetic resonance in neutron irradiated silicon; Low temperature specific heat of reduced $TiO_2$ (Rutile); Calorimetric study of vanadium in the superconducting, normal, and mixed states; Polaron in a magnetic field. TAB

**N66-14201*#** Goodyear Aerospace Corp., Akron, Ohio.
**A STUDY OF WIDE ANGLE OPTICAL SYSTEMS FOR USE IN VISUAL SIMULATIONS Final Report, 29 Dec. 1964–29 Jun. 1965**
26 Jul. 1965 287 p refs
(Contract NAS8-11775)
(NASA-CR-62022; GER-12103-S/4) CFSTI: HC $6.00/MF $1.50 CSCL 20F

This program was undertaken to advance the current state of the art in the field of wide angle optical systems used to generate visual displays for manned space flight simulation. Literature on wide angle optical systems and related subsidiary components and subsystems was surveyed. Basic types of optical systems design were studied to determine their advantages and disadvantages in regard to the intended application. Results of the survey are cited and detailed specifications for advanced optical pickup systems together with design information pertaining to recommended technical approaches are presented. The most highly developed optical pickup devices are those

with an approximate field of view of 60 degrees. This was based on best overall system performance characteristics. The single objective oblique optics system is considered the best practical approach for improving optical pickup systems with regard to angular field, depth of field, and minimum working distance. This system can be used with any standard television system link and thereafter displayed on a television monitor or by projection. R.N.A.

**N66-14204#** Sprague Electric Co., North Adams, Mass.
**PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, Mar. 29–Jun. 29, 1965**
J. M. Eckfeldt and J. H. D. Folster [1965] 11 p refs
(Contract DA-36-039-AMC-03621(E))
(QR-8; AD-623107) CFSTI: HC $1.00/MF $0.50

The production run of 9150 capacitors of nine different ratings for the 10000-hr extended life test was continued. Processing of these lots is now approximately 95% complete. The screening prescribed by Specification MIL-C-39003 is more than 50% complete. TAB

**N66-14206#** California Univ., Berkeley. Electronics Research Lab.
**THEORETICAL INVESTIGATION OF A NONPLANAR FIELD-EFFECT TRANSISTOR**
S. R. Levine 7 Jul. 1965 65 p refs
(Contract DA-31-124-ARO(D)-385; Grant AF-AFOSR-139-65)
(ERL-M-122; AROD-5537-2; AD-623593) CFSTI: HC $3.00/MF $0.75

The report applies the generalized analysis of planar field-effect transistors developed by Richer to the calculation of theoretical performance in a volume field-effect transistor. Richer's analysis is illustrated first, then the mathematical techniques are extended to cover the case of an arbitrarily-shaped volume FET. This extended general analysis is then applied to a FET with circular cylindrical geometry. Graphs of computer solutions of FET drain current, drain-voltage characteristics, and of equivalent circuit element values are presented. The characteristics of the planar and cylindrical FET's are compared. Author (TAB)

**N66-14212#** Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Systems Div.
**DESIGN MODIFICATION AND CONSTRUCTION OF HIGH POWER DEUTERIUM THYRATRONS Second Quarterly Report, 15 Jul.–15 Oct. 1965**
Nicholas Reinhardt 12 Nov. 1965 6 p ref
(Contract NObsr-89405)
(B-3193; AD-623636) CFSTI: HC $1.00/MF $0.50

A second phase of development of the high-power deuterium thyratron was entered into (for first phase see AD-610-548). Emphasis was on incorporating improvements which will insure long term stability of various cathode parameters. A revised cathode structure was designed and fabricated using short lead time techniques. Details of this design and preliminary evaluation of the performance of the tube in which it was incorporated are given. TAB

**N66-14226#** Filtron Co., Inc., Flushing, N. Y.
**INTERFERENCE REDUCTION GUIDE FOR DESIGN ENGINEERS, VOLUME II. CHAPTER III: CIRCUIT DESIGN**
Ft. Monmouth, N. J., Army Electron. Lab., 1 Aug. 1964 445 p refs
(Contract DA-36-039-SC-90707)
(AD-619667) CFSTI: HC $7.50/MF $2.00

The causes for interference are examined in relation to circuit design, and recommendations for interference reduction are made. Areas discussed include components; filters, capacitors, and inductors; power supplies; control circuitry; receivers; transmitters; antennas; computers; microminiaturization; and electrical machinery. Figures and graphs delineate the text. A bibliography is also included listing articles, papers, reports, and texts dealing with general interference problems. M.G.J.

**N66-14229#** Electronic Films, Inc., Burlington, Mass.
**LOW-COST MICROCIRCUIT NETWORKS Third Quarterly Progress Report, 1 Apr.–31 Jul. 1965**
W. Mac Donald 31 Jul. 1965 27 p
(Contract DA-28-043-AMC-00284(E))
(Rept.-3; AD-623314) CFSTI: HC $2.00/MF $0.50

Thin film resistor networks can be produced in the 0.310 × 0.310 wafer size at a per resistor cost ranging between 3.5 and 3.8 cents per resistor. This is best accomplished by cutting the 0.310 wafer out of a larger wafer (1 × 1 inch or larger) after the wafer has been processed through ^h etching step. This procedure cuts down the wafer handling cost and permits the production of the low cost resistor. The load life stability of the chromium film resistor is very good. An 0.38% average change in resistor value was obtained after 500 hours exposure to 1/4 watt at 125C. The copper conductor degrades this performance by oxidizing. A gold conductor was used to obtain the high stability figure. Author (TAB)

**N66-14230#** Radio Corp. of America, Camden, N. J. Defense Electronic Products.
**MICROELECTRONIC SOLID-STATE DISPLAY ASSEMBLY Interim Development Report, 8 Jun.–1 Sep. 1965**
[1965] 29 p
(Contract NObsr-93320)
(IDR-1; AD-623138) CFSTI: HC $2.00/MF $0.50

The work performed during this reporting period and described herein involved for the most part preparation for the configuration and fabrication studies that will be performed during the next two quarters. The essential features of the program plan, mask fabrication, CdSe preparation, and the testing circuitry are described. Tests made to determine the flatness of TiC etched glass and the variation of gap separation in the sandwich structure are also reported. The purpose of this program is to perform exploratory development of a Microelectronic Solid-State Display Assembly based on the molecular property of hysteresis in the electrical conductivity of cadmium selenide (CdSe). This hysteresis property can be used as a switch to control an electroluminescent (EL) element, and a major effort of the program is to demonstrate the feasibility of mass producing the CdSe-EL combination for use in low-cost displays. Author (TAB)

**N66-14314#** Army Electronics Labs., Fort Monmouth, N. J.
**HF AND VHF QUARTZ-FILTER-CRYSTAL DESIGN CONSIDERATIONS**
Theodore J. Lukaszek Jul. 1965 33 p refs
(ECOM-2615; AD-623507) CFSTI: HC $2.00/MF $0.50

Studies into the problems associated with the design of quartz filter crystals in the HF and VHF range have resulted in design data for producing crystal units with a wide range of equivalent circuit parameters while still maintaining a suppression of unwanted modes to approximately 40 db. To plate thickness ration together with the total mass deposition. In essence, to obtain a wide range of the equivalent electric circuit parameters, it is necessary to vary the electrode size. An adequate suppression of unwanted modes is assured by a

proper selection of mass loading. The proper choice of mass loading one must use has been investigated extensively at this Command in an effort to determine, first, the optimum plating thickness which will give the required mass loading for maximum suppression of unwanted modes, and secondly, to determine the range of electrode thicknesses that can be used on either side of this optimum, and still maintain a 40 db suppression, i.e., amplitude of unwanted modes vs. plate back information. Having this, a criterion can be established on the tolerance of the unplated wafer frequency. Design information resulting from these investigations with filter crystals operating on the fundamental and fifth overtone is presented. TAB

# 10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

**N66-13301#** Joint Publications Research Service, Washington, D. C.
**NEWS OF THE ACADEMY OF SCIENCES USSR DEPARTMENT OF TECHNICAL SCIENCES, TECHNICAL CYBERNETICS, NO. 4, 1965**
30 Nov. 1965 293 p refs Transl. into ENGLISH of Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhnicheskaya Kibernetika (Moscow), no. 4, Jul.–Aug. 1965 p 1–200
(JPRS-33086; TT-65-33663) CFSTI: $6.00

Articles on control systems, dynamic systems, design of logical devices, and linear and nonlinear programming are presented. For individual titles see N66-13302–N66-13329.

**N66-13302** Joint Publications Research Service, Washington, D. C.
**SOME GAME SITUATIONS IN CONTROL SYSTEM THEORY**
N. N. Krasovskiy, Yu M. Repin, and V. Ye. Tret'yakov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 1–17 refs (See N66-13301 04-10) CFSTI: $6.00

Problems investigated are concerned with the meeting of controlled movements, including the condition of maximum time of encounter. A procedure for selecting the control is investigated. The general conditions are illustrated by simple mechanical movements simulated on computers. Author

**N66-13303** Joint Publications Research Service, Washington, D. C.
**STATISTICAL STABILITY OF THE MOTION OF NONLINEAR DYNAMIC SYSTEMS AND INTEGRAL EVALUATIONS OF MOMENTS**
A. A. Krasovskiy *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 18–31 refs (See N66-13301 04-10) CFSTI: $6.00

Dynamic systems investigated are described by nonlinear differential equations with analytical functions under random initial conditions. The mathematical expectancies and an infinite series of moments of the coordinates of such systems are determined by an infinite system of linear differential equations. If for arbitrary initial values all the moments approach zero with the passage of time, then the undisturbed motion has statistical stability. In the presence of statistical stability the integral values of the moments are investigated as determined by an infinite system of linear algebraic equations. A procedure recommended for sequential solution of the equations permits the finding of approximate expressions for the integral values of the moments by the coefficients of the initial system of equations and the initial values of the moments. Examples are presented for the selection of the parameters of nonlinear dynamic systems based on the use of integral values of the moments. Author

**N66-13304** Joint Publications Research Service, Washington, D. C.
**ON THE INFLUENCE OF THE CHARACTERISTICS OF METERING DEVICES ON ACCURACY OF PREDICTION OF TRAJECTORIES OF PHYSICAL PROCESSES**
Yu. I. Parayev *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 32–42 refs (See N66-13301 04-10) CFSTI: $6.00

Consideration is given to a metering device which measures the coordinates of a physical process, the errors which accompany these measurements, and errors and other factors affecting the accuracy in predicting the trajectory of the process. Two problems are set up; one which will find a k-dimensional vector to minimize the average value of the loss function; the second which will select the best metering device. The problem is linearized, and solutions are evolved for cases where measurements are carried out (1) discretely and (2) continuously. Entropy of the optimal estimate is discussed. M.W.R.

**N66-13308** Joint Publications Research Service, Washington, D. C.
**ON THE LIFETIME OF STOCHASTIC AUTOMATA**
E. M. Vaysbord and G. Sh. Rosenstein *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 75–86 refs (See N66-13301 04-10) CFSTI: $6.00

The concept of an unstable automaton and its lifetime are considered for an automatic control system found in a stationary external environment. A mathematical model for the unstable system is described and the problem is defined. Maximizing the lifetime of the stochastic automaton is considered by optimal selection of its output function which is really optimal switching of the external medium affecting the automaton. The proposed method of sequential approximations is easily realized on a computer, and the convergence of the method is proved. M.W.R.

**N66-13309** Joint Publications Research Service, Washington, D. C.
**FUNCTIONAL DIVISIBILITY IN MAJORITAL SYSTEMS**
V. I. Varshavskiy and L. Ya. Rosenblum *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 87–93 refs (See N66-13301 04-10) CFSTI: $6.00

Procedures are investigated for the construction of automatic control systems based on the property of functional divisibility or decomposition of logical functions. Both simple and complex majorital decomposition were investigated, but no one kind was found to be preferable. The equivalence classes of three variable functions are tabulated, and solutions are given for these functions. It is suggested that the procedures outlined can result in systems which are very close to optimal. M.W.R.

**N66-13310** Joint Publications Research Service, Washington, D. C.
**APPLICATION OF THE METHODS OF GRAPH THEORY TO THE SYNTHESIS OF POTENTIAL SYSTEMS**
A. V. Kalyayeva, Yu. A. Dvoryantsev, and A. N. Melikhov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 94–101 refs (See N66-13301 04-10) CFSTI: $6.00

Improvement of the method for synthesis of automatic control systems using rapid action or trigger memories is discussed. Consideration is given to the duration of the potential signals at the input of the automaton, and a synchronization method is proposed which is based on the breakdown of a set of vertices of the graph for the memory input functions. An example is given of the synthesis of a potential trigger system which makes use of the breakdown. This represents a device used for realization of the differentiation operation in digital integrators. M.W.R.

**N66-13311** Joint Publications Research Service, Washington, D. C.

**ON THE PROBLEM OF DESIGN OF COMBINATION LOGICAL DEVICES**

M. Ye. Stein *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 102–111 refs (See N66-13301 04-10) CFSTI: $6.00

The use of certain codes which characterize the implicants of a Boolean function is considered in terms of evaluation of the number of implicants. Since the design of automated digital devices requires the minimization of these functions, a method is proposed which decreases the selection when obtaining the reduced disjunctive normal form of Boolean function. Programming on a digital computer indicates that ordering time is immeasurably smaller than selection time; and the selection itself for a function of 10 variables may be reduced by one or two. M.W.R.

**N66-13312** Joint Publications Research Service, Washington, D. C.

**AN ALGORITHM FOR CONSTRUCTION OF A FORMAL NEURON WITH OPTIMAL PARAMETERS**

F. O. Mkrtchyan *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 112–130 refs (See N66-13301 04-10) CFSTI: $6.00

An algorithm is described for construction of a neuron from a given threshold diagram. A threshold Wenn diagram is shown for a neuron with three inputs; and this is broken down into three sub-diagrams designated X, Y, and Z. Uniting the equations from the original diagram and the three sub-diagrams results in a system with 13 equations where the number of unknowns exceeds the number of equations by five. Allowable optimizing combinations of the given unknown are considered, and tables are presented with data applicable to the construction of the neuron. An optimal formal neuron, drawn to satisfy the original threshold diagram, is given, which is useful in the synthesis of a logically stable neuron network. M.W.R.

**N66-13315** Joint Publications Research Service, Washington, D. C.

**ON OPTIMAL SELECTION OF THE PARAMETERS FOR AUTOMATIC CONTROL OF RADIO ELECTRONIC APPARATUS**

V. P. Golovenkin *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 154–159 refs (See N66-13301 04-10) CFSTI: $6.00

The information criterion for objectiveness of control in the definition of an optimal makeup for the controlled parameters is introduced. It is shown that the introduction of this criterion permits the solution of the initial problem by the methods of nonlinear programming. Author

**N66-13316** Joint Publications Research Service, Washington, D. C.

**DETERMINATION OF THE DYNAMIC CHARACTERISTICS OF A CLOSED NONSTATIONARY SYSTEM IN THE NORMAL CONDITION OF ITS OPERATION**

Ye. A. Gel'Fandbeyn *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 160–165 refs (See N66-13301 04-10) CFSTI: $6.00

The diagnostic problem related to the determination of the dynamic characteristics of the nonstationary object of control is investigated together with the dynamic characteristics of the system as a whole in the process of normal operation. For determination of the characteristics, recordings of signal error and the output coordinate are used. The influence of internal noise is considered as well as the noise from the measurements. Author

**N66-13318** Joint Publications Research Service, Washington, D. C.

**SYNTHESIS OF CORRECTION DEVICES FOR LINEAR SYSTEMS WITH GIVEN ACCURACY AT A FIXED POINT IN TIME**

V. F. Levitin and V. A. Skripkin *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 173–181 refs (See N66-13301 04-10) CFSTI: $6.00

The concept of equivalent systems is introduced, the accuracy of which is identical at a fixed point in time; the properties of equivalent systems are investigated; and formulas are obtained for the determination of the transfer function of a stationary correction link. Author

**N66-13319** Joint Publications Research Service, Washington, D. C.

**ON INVESTIGATION OF A CLASS OF CONTROL SYSTEMS BY THE METHOD OF CROSS SECTIONS OF THE PARAMETER SPACE**

R. A. Nelepin *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 182–195 refs (See N66-13301 04-10) CFSTI: $6.00

By isolating linear subspaces or hyperplanes in difference parameter spaces of nonlinear automatic control systems, it is possible to investigate the problems of a linear system of the nth order in the same way as systems of the 1st and 2nd order with the same nonlinearities. For the investigated cross sections, smooth diagrams are obtained for breakdown of the planes into regions which correspond topologically to the defined types of the phase picture of motion. System roughness is resolved individually for each of the cross sections. The cross sections do not represent any strange insertions into the parameter space; and bifurcational curves have a natural extension beyond the cross sections in which they were discovered. M.W.R.

**N66-13320** Joint Publications Research Service, Washington, D. C.

**ON LOWERING THE SENSITIVITY TO CHANGE OF PARAMETERS IN A SELF-ADJUSTING SYSTEM WITH A MODEL**

I. N. Krutova and V. Yu. Rutkovskiy *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 196–214 refs (See N66-13301 04-10) CFSTI: $6.00

A system is investigated with a standard model in which a coefficient of amplification of the regulator $K_0$ is tuned depending on the difference of the output coordinate of the model and

the system and the differences in their derivatives (the problem of sensitivity). It is shown that the appropriate choice of the law of variation of $K_0$ may make the system stable or autooscillatory when changing the coefficients of the equation of the initial system within wide limits, including the negative values. Author

**N66-13321** Joint Publications Research Service, Washington, D. C.

**ON OPTIMAL CHARACTERISTICS OF A NONLINEAR TRANSFORMER IN THE PRESENCE OF NOISE**

Ye. P. Gil'bo *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 215–224 refs (See N66-13301 04-10) CFSTI: $6.00

The problem of synthesis of a nonlinear transformer is investigated for random input signals with normal laws of distribution. Estimations of the critical reaction of the system to the type of nonlinearity, depending on the ratio of useful signal to noise, and the type of the desired nonlinear transformation are presented. Author

**N66-13322** Joint Publications Research Service, Washington, D. C.

**THE SYNTHESIS OF OPTIMAL CONTROL OF A SYSTEM OF THE SECOND ORDER**

L. M. Koziorov and Yu. I. Kupervasser *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 225–236 refs (See N66-13301 04-10) CFSTI: $6.00

The optimal control is defined which minimizes the quadratic functional for an object described by two sequential integrating links. The limitation $|u| \leq u$ is imposed on the control. It is shown that the optimal control in some region of the phase coordinate differs from the linear limited control. An expression is given which approximates the optimal control in the entire phase plane. Some results of simulation are supported by the analytical expressions. Author

**N66-13323** Joint Publications Research Service, Washington, D. C.

**A PROCEDURE FOR SEQUENTIAL SYNTHESIS OF OPTIMAL RAPID ACTION CONTROL**

Ya. A. Bedrov and L. Ye. Kanarev *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 237–246 refs (See N66-13301 04-10) CFSTI: $6.00

The problem of synthesis of optimal rapid action control is investigated for objects which are described by a system of linear differential equations with constant coefficients. The method of sequential synthesis of optimal control and a synthesis algorithm using a continuous action computer are proposed for a system of arbitrary order with one master control organ in the case of real roots for the characteristic equation. Author

**N66-13324** Joint Publications Research Service, Washington, D. C.

**COMPENSATION FOR THE FORCED COMPONENT OF MOTION IN SYSTEMS WITH VARIABLE STRUCTURE**

V. I. Utkin *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 247–253 refs (See N66-13301 04-10) CFSTI: $6.00

An automatic control system is investigated which has variable structure and which is used for the control of a linear object with accuracy up to the damping transition component when disturbance forces are acting on the object. It is shown that the stated problem may be solved by using commutation circuits in the main and local feedback circuits by a determinant logical law. Author

**N66-13325** Joint Publications Research Service, Washington, D. C.

**THE CONSTRUCTION OF AUTOMATIC CONTROL SYSTEMS WITH THE USE OF COMMUTED PHASE SHIFT FILTERS**

V. A. Taran *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 254–266 refs (See N66-13301 04-10) CFSTI: $6.00

The construction of an automatic control system with variable structure for linear objects is investigated. In the systems investigated commutation of the circuits is accomplished in a regulator during the transition process according to some logical law. For control of the switching circuit, an error signal is used which is converted by a phase shift filter. The structure of the phase shift filter varies simultaneously with commutation of the networks in the regulator. Author

**N66-13327** Joint Publications Research Service, Washington, D. C.

**ANALYSIS OF THE STABILITY OF AUTOMATIC SYSTEMS WITH RANDOM PARAMETERS**

G. S. Chernorutskiy *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 275–280 refs (See N66-18301 04-10) CFSTI: $6.00

Analysis and synthesis of the stability of automatic control systems for random fixed choices of many parameters are realized through broad use of the Mikhaylov criterion. It is assumed that the system contains links with both constant and randomly-selected parameters, and that the structure of the system as well as the form of the transfer functions are invariant. For random parameters of the links of the system, determination is made of the corresponding mathematical expectancies, the dispersions of the centered variables, the mean square deviations, and the other numerical characteristics. The numerical values of the automatic control system parameters are usually random variables which are dependent on random variations and random tuning conditions. Selection of these numerical values is random although the system may remain fixed in terms of structure. Stability of the system with random parameters may be checked by analysis of dispersion stability and the Mikhaylov hodograph. M.W.R.

**N66-13333#** Joint Publications Research Service, Washington, D. C.

**MODERNIZATION OF MEASURING TECHNIQUES THROUGH CYBERNETICS**

12 Nov. 1965 35 p refs Transl. into ENGLISH from Avtometriya, Novosibirsk, no. 4, 1965 p 17–21, 28–35, 43–48, 49–54 (JPRS-32840; TT-65-33418) CFSTI: $2.00

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2. ONE ALGORITHM OF CONTROL OF INFORMATION COLLECTION V. A. Vittikh and A. N. Ginsburg p 8–17 refs (See N66-13335 04-10)

3. ANALOG AND DISCRETE SIGNAL TRANSFORMATIONS BY NEURONS G. D. Umantsev p 18–25 refs (See N66-13336 04-10)

4. TRANSFORMATION OF SIGNALS IN PERIPHERAL SECTIONS OF BIOLOGICAL ANALYZERS L. A. Nazarov and G. D. Umantsev p 26–33 refs (See N66-13337 14-10)

**N66-13334** Joint Publications Research Service, Washington, D. C.

**SELECTION OF PARAMETERS OF MEASURING SYSTEMS DURING OPTIMUM OPERATION**

V. M. Aleksandrov *In its* Modernization of Measuring Tech. Through Cybernetics 12 Nov. 1965 p 1–7 refs (See N66-13333 04-10) CFSTI: $2.00

For second degree linear systems with operation by the increment of the input signal, the selection of a coefficient of the first derivative, guaranteeing the shortest time of the transitive process, is examined. Recommendations are given on the selection of coefficients during practical solution of such systems. Author

**N66-13335** Joint Publications Research Service, Washington, D. C.

**ONE ALGORITHM OF CONTROL OF INFORMATION COLLECTION**

V. A. Vittikh and A. N. Ginsburg *In its* Modernization of Measuring Tech. Through Cybernetics 12 Nov. 1965 p 8–17 refs (See N66-13333 04-10) CFSTI: $2.00

An algorithm for control of collection of information from a source of a continuous signal, based on a two step integrated signal, is examined, and a functional structure realizing the given algorithm is proposed. Author

**N66-13336** Joint Publications Research Service, Washington, D. C.

**ANALOG AND DISCRETE SIGNAL TRANSFORMATIONS BY NEURONS**

G. D. Umantsev *In its* Modernization of Measuring Tech. Through Cybernetics 12 Nov. 1965 p 18-25 refs (See N66-13333 04-10) CFSTI: $2.00

This paper examines analog and discrete signal transformations by neurons. A description is given of models of neurons fulfilling these transformations. Author

**N66-13337** Joint Publications Research Service, Washington, D. C.

**TRANSFORMATION OF SIGNALS IN PERIPHERAL SECTIONS OF BIOLOGICAL ANALYZERS**

L. A. Nazarov and G. D. Umantsev *In its* Modernization of Measuring Tech. Through Cybernetics 12 Nov. 1965 p 26–33 refs (See N66-13333 04-10) CFSTI: $2.00

Certain properties of receptors and data units are compared; individual principles of organization of receptor fields are examined. A block circuit of a comutator using these principles is presented. Author

**N66-13341** Library of Congress, Washington, D. C. Aerospace Technology Div.

**SOME NEW CONCEPTS OF MINIATURIZATION OF STORAGE ELEMENTS**

Russell R. Zavistovich *In its* Foreign Sci. Bull., Vol. 1, No. 10, Oct. 1965 p 1–5 refs (See N66-13340 04-34)

A review is presented of a theoretical study on microminiaturization of electronic elements. The ideas advanced in the study deal with the behavior of the living molecular mechanism and the utilization of the knowledge of this behavior in the production of electronic storage elements consisting of individual atoms and molecules. The possible approaches to experimentation are outlined. Author

**N66-13503#** General Electric Co., Schenectady, N. Y. Research Lab.

**CONSEQUENCES OF THE CONDITIONAL MEAN CONTROL OF LINEAR PLANTS**

W. G. Tuel, Jr. Apr. 1965 22 p refs

(Rept.-65-RL-3924-E)

This report presents a study of the effect of control on the probability distribution of the error index in a linear optimum control problem. For a known plant of low order, the results are analytically obtained and easily visualized. For unknown plants whose parameters are represented by probability distributions, the first three moments of the error index are computed. The mean and variance become impossibly large as the variance of the parameter value increases. This indicates that the optimum control problem for unknown systems may not be well formulated. Author

**N66-13558*#** Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

**GEOMETRICAL INTERPRETATION AND GRAPHICAL SOLUTION TO MINIMUM ENERGY DISCRETE-DATA CONTROL Scientific Report No. 9**

A. M. Revington and J. C. Hung 15 Jun. 1965 20 p refs (Grant NsG-351)

(NASA-CR-68498) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Compact and simple design equations have been previously obtained for the minimal energy design of a linear PAM regulator by working not in the state space, but in a new space, the "canonical space." The input sequence is split into two sections and the minimal energy conditions is a simple relation between the two parts of the input. The relation is used here to give a direct method of finding what states can be taken to the origin, using the linearly designed input sequence, without violating a saturation constraint. For second order systems the technique is particularly useful in that a simple graphical technique is possible. An example demonstrates the method. Author

**N66-13599#** Syracuse Univ., N. Y. Dept. of Electrical Engineering.

**NTH ORDER, QUASI-HARMONIC OSCILLATORS**

Theodore A. Bickart and Stephen G. Dick Griffiss AFB, N. Y., RADC, Oct. 1965 36 p refs

(Contract AF 30(602)-3538)

(TM-65-2; RADC-TR-65-275; AD-623506) CFSTI: HC $2.00/MF $0.50

The report contains an expository treatment of oscillator systems which can be modeled as an Nth order nearly linear system, the linear portion of which can be described by a conjugate pair of roots. The results are consistent with those of Loeb's paper (in French) of 1956. The contribution is in the establishment of the main results by way of an alternative development. Author (TAB)

**N66-13955#** Syracuse Univ., N. Y. Electrical Engineering Dept.

**EXPONENTIAL DESCRIBING FUNCTIONS FOR THE ANALYSIS OF TRANSIENT PHENOMENA**

Theodore A. Bickart Griffiss AFB, N. Y., RADC, Oct. 1965 35 p refs

(Contract AF 30(602)-3538)

(TM-65-4; RADC-TR-65-276; AD-623488) CFSTI: HC $2.00/MF $0.50

Essentially bounded, square integrable functions over the infinite past are represented by growing exponentials. The memory of a system is associated with the signal representation. The system operation is then characterized by an algebraic input-output relationship. A generic feedback system is treated in detail. The contraption-mapping fixed-point theorem is used to develop conditions for the existence of a solution prior to establishing the approximating system. The concept of practical ultimate boundedness is given as a tool to enlarge the class of systems open to analysis. Author (TAB)

**N66-14023#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**CONCEPTUAL DESCRIPTION OF A FAMILY OF FREQUENCY SYNTHESIZERS**
Brian E. White 8 Sep. 1965 22 p
(Contract AF 19(628)-5167)
(TN-1965-43; ESD-TDR-65-421; AD-621510) CFSTI: HC $1.00/MF $0.50

A family of frequency synthesizers is described. Each member of the family generates one of many equally-spaced frequencies by utilizing identical modules, the number of which is related to the number of possible frequencies. For any design in the family which uses frequency division in the modules, there exists a dual design which utilizes frequency multiplication. Block diagrams and formulas are included which may be useful in designing frequency synthesizers for communication system applications. Author (TAB)

**N66-14221#** Cornell Univ., Ithaca, N. Y.
**AMPLITUDE-LIMITED CONTROL OF LINEAR, DISCRETE SYSTEMS WITH QUADRATIC ERROR MEASURE**
Philip Auten Reynolds (Ph.D. Thesis) Sep. 1965 152 p refs
(AD-622513) CFSTI: HC $5.00/MF $1.00

The problem of finding a sequence of N amplitude limited controls which minimizes a quadratic error measure over N sampling intervals is studied. The error measure is the integral of a quadratic form in the state of the plant and the control variable. Conditions governing the uniqueness of the solution to the optimization problem are investigated. A new algorithm for solution of the problem is presented, and other methods of solution are discussed in the light of their possible use as part of a real-time controller. The algorithm is similar to the simplex algorithm of linear programming, but it solves the problem using fewer variables and equations. The logic involved in the algorithm is more complicated. Three controllers based on the N-stage optimization problem—constant-N, periodic-N, and dual-mode—are studied. Necessary conditions for asymptotic stability in the large are stated for both the constant-N and the periodic-N controllers. These conditions are also sufficient for asymptotic stability in a restricted region of state space. TAB

**N66-14299*#** General Dynamics/Convair, San Diego, Calif.
**PHASE 1, SIMULATION OF SELECTED DISCRETE NETWORKS. VOLUME ONE: THE LOGIC MODEL Final Report**
Sep. 1965 41 p
(Contract NAS8-20016)
(NASA-CR-68972; GDIC-DDF-65-005) CFSTI: HC $2.00/MF $0.50 CSCL 09C

The methodology for constructing a discrete network system model is discussed. The network is described by a set of Boolean equations which completely define all interrelationships, and by a characteristic activity time associated with each variable (the time required for the effective change of state of a particular variable), which forms a complete mathematical model of a physical system. Data necessary for model building are defined, and the basic Boolean equations used in a simulation are developed. The methods used to write the model, based on the concept of the elementary Boolean equations, are described in detail. Variables are classified as active and inactive, and it is pointed out that this division holds to a minimum the number of variables with which the simulation must actively work. Classifications for equations are given, along with the format for equation cards and time cards. It is also emphasized that consistency is of great importance in building a model. M.G.J.

**N66-14325#** Harvard Univ., Cambridge, Mass. Cruft Lab.
**THE CHARACTERIZATION AND IDENTIFICATION OF SYSTEMS**
Charles R. Arnold and Kumpati S. Narendra 18 Jun. 1965 87 p refs
(Contract Nonr-1866(16))
(TR-471; AD-623145) CFSTI: HC $3.00/MF $0.75

This report provides a fairly exhaustive survey of deterministic models for the characterization of systems and of the techniques available for the subsequent identification of some physical system in terms of each of the various classes of models. The term 'system' refers, in general, to a nonlinear system and the major emphasis of the report is thus upon nonlinear models and their identification requirements. Most of the ideas presented in this report are not new. However, many of them are not widely known in the engineering field and it was thus felt desirable to collect, organize, and present them as clearly as possible for the engineer. Author (TAB)

# 11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

**N66-13374*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CHARACTERISTICS AND FORMAT OF THE TRACKING DATA TO BE OBTAINED BY THE NASA DEEP SPACE INSTRUMENTATION FACILITY FOR LUNAR ORBITER**
J. Lorell, J. D. Anderson, and W. L. Sjogren 15 Jun. 1965 38 p refs
(Contract NAS7-100)
(NASA-CR-68619; JPL-TM-33-230) CFSTI: HC $2.00/MF $0.50 CSCL 22D

Information is presented which concerns the Deep Space Instrumentation Facility tracking data format and characteristics. It is intended as an explanatory supplement for users of the data to explain the meaning of the data, the locations of the instruments, the biases, the precision and accuracy, the reduction to geometrical quantities, and the format for distribution. R.N.A.

**N66-13399*#** Aeronutronic, Newport Beach, Calif.
**FACSIMILE AND ACCELEROMETER SYSTEMS INTEGRATION STUDY Interim Report**
15 May 1962 150 p Prepared for JPL
(Contract NAS7-100; JPL-950267)
(NASA-CR-50432; U-1658) CFSTI: HC $5.00/MF $1.00 CSCL 22A

A previous report describes the general features of two lunar vehicles capable of returning detailed data from the lunar surface at an early date using the Ranger delivery system. The first of these vehicles is a Facsimile System, or Lunar Surface Photoreconnaissance Capsule (LSPC), intended to

reproduce on earth a photograph showing in fine detail a panoramic view of the lunar landscape. The second vehicle is an Accelerometer System, or Lunar Surface Measurement Capsule (SURMEC), intended to measure directly the lunar surface strength characteristics at a number of dispersed points on the surface. This report presents a systems integration study of these two systems. It also presents, for each capsule, sections covering mission objectives and design criteria, system design characteristics and restraints, and a brief discussion of analytical and design effort on system tradeoffs.
Author

**N66-13439#** Army Nuclear Defense Lab., Edgewood Arsenal, Md.
**THE US ARMY NUCLEAR DEFENSE LABORATORY'S POSITIVE ION ACCELERATOR**
John C. Goshorn, Jr. Oct. 1965 24 p refs
(NDL-TM-22; AD-473825)

The Cockcroft-Walton Positive Ion Accelerator, installed at US Army Nuclear Defense Laboratory, Edgewood Arsenal, Maryland, has a maximum energy of 650 keV, is capable of producing a direct current beam of approximately 1-mA of low-Z nuclei, or of producing beam pulses 2 to 15 ns wide and 2 mA in amplitude. This report describes the accelerator, the accelerator's enclosure, and some of the accelerator's capabilities. Author(TAB)

**N66-13631#** Frankford Arsenal, Philadelphia, Pa.
**PHASE SENSITIVE EDDY CURRENT TEST EQUIPMENT**
Theodore A. Cox Aug. 1965 24 p ref
(M66-2-1; AD-621844) CFSTI: HC $2.00/MF $0.50

Nondestructive test equipment was developed to detect an eddy current signal voltage and to automatically resolve it into in-phase and quadrature components. The equipment was then used to perform various tests for the determination of its applicability to hardness measurements of ferrous materials and case depth measurements of ferrous parts. Test results using the automatic phase detection technique were promising, and it is believed that practical systems can be developed for the automatic hardness testing of ferrous materials. Deficiences in the uniformity of metallurgical characteristics of the reference materials prevented linear correlations from being achieved. Special emphasis will be placed on the procurement of specimens with the desired metallurgical characteristics during the next phase of the program. Author(TAB)

**N66-13661#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**PULSED MAGNETIC FIELDS APPARATUS [USTANOVKA IMPUL'SNYE MAGNITNYE POLYA]**
V. K. Makar'in and V. P. Partem'nov 1965 22 p refs In RUSSIAN
(IAE-795) CFSTI: HC $1.00/MF $0.50

Apparatus for obtaining pulsed magnetic fields in the operating conditions at contemporary elementary-particle accelerators is described. The apparatus consists of a charging device, an energy storage device, a discharge mechanism, and pulsed magnets. Pulsed magnetic fields of $\overline{H}$ = 65 kOe in a volume of 12 liters and $\overline{H}$ = 100 kOe in a volume of 8 liters were obtained using the apparatus described. NSA

**N66-13726#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**FUEL-HEATING UNITS FOR AIRCRAFT TEST STANDS**
L. S. Arinushkin, Yu. V. Belyayev et al 17 Sep. 1965 5 p Transl. into ENGLISH of Soviet Patent no. 157176 (Appl. no. 695200/40-23, 30 Jan. 1961) 3 p
(FTD-TT-65-774/1+2+4; AD-622384) CFSTI: HC $1.00/MF $0.50

Object of the invention: A unit for preheating fuel in aircraft test stands, which includes in itself a preheater of the liquid heat carrier with electrical heaters and a pump as well as a preheater of the fuel with coil-pipe heat exchangers, joined by tube connections which has the distinguishing feature that for the purpose of shortening the time and expenditure of electrical energy for heating the heat carrier and the fuel, and also for simplifying the design and operation of the unit, it in the preheater of the heat carrier is constructed in the form of two coaxial vertically disposed cylinders, provided with electrical heaters while at the same time in the cavity of the lesser cylinder there is mounted a pump joined by a vertical shaft with a two-speed electrical motor which assures the circulation of the heat carrier through the pipe coils of the preheater of the fuel or the controllable crossover connection in the heating up of the heat carrier. Author(TAB)

**N66-13802#** AiResearch Mfg. Co., Phoenix, Ariz.
**GEM CONTROL SYSTEM STUDY Final Engineering Report**
Donald E. Litherland and W. M. Norgren 16 Aug. 1965 227 p refs
(Contract Nonr-3173)
(AP-5078-R; AD-620964) CFSTI: HC $6.00/MF $1.25

As reported in AP-5073-R (AD-604 894), prior to 1964, the AiResearch GEM Control System Study consisted of an analog computer dynamic simulation of ground effect machines (GEM's) and a developmental operator's control station, visual generator, and control unit. The primary object of the work performed on this contract since the last progress report was to design, construct, and calibrate a completely universal GEM simulator. Author(TAB)

**N66-13985#** Naval Research Lab., Washington, D. C.
**A STUDY OF THE GAS TURBINE POWERED MB-5 AIRCRAFT FIREFIGHTING AND RESCUE VEHICLE**
H. B. Peterson and R. L. Gipe 22 Sep. 1965 25 p refs
(NRL-6309; AD-623296) CFSTI: HC $2.00/MF $0.50

One of the MB-5 series of crash trucks was equipped with a gas turbine engine as a source of power. During the testing of this vehicle the operating characteristics of the engine were monitored under different load conditions, variable road speed, and variable foam pump speed. The turbine-powered vehicle was compared to other, conventional engine model, trucks now in operation, both for rapidity of acceleration and for ease of operation. A standardized simulated firefighting operation called a 'scramble' operation was devised for the integration of human engineering with the relative efficiency of each of the three vehicles. Time intervals required to reach a given series of check points during a fixed firefighting procedure were recorded by multichanneled instrumentation or by observation. The turbine-powered vehicle proved to be superior in acceleration performance and equal in firefighting capability to conventional engines. These factors alone may not justify the higher initial cost of the turbine power plant. Author(TAB)

**N66-14114*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THRUST-MEASUREMENT STAND DESIGN CONSIDERATION**
J. C. Heins *In its* Goddard Summer Workshop Program [1964] 11 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

Several different types of satellite attitude-correction systems are available and have been incorporated into satellite designs. It has been suggested that the original analysis of problems of satellite dynamics involving thrusters be performed on an analog computer, the impulse used in the computer solution being obtained from the actual firing of a rocket. This would be accompanied by mounting the thruster on a suitable thrust-measuring device in a vacuum environment and determining the impulse from the measured thrust. One such thrust-measuring device is considered in detail and the practicability and accuracy of several other devices are discussed. The study of an isolated single-degree-of-freedom thrust stand with linear spring and dashpot has indicated that a good approximation to the total impulse of a rocket may be obtained by integrating the spring force with respect to time under certain specified conditions. An exact measurement of a short-thrust pulse with a single-degree-of-freedom thrust stand is impossible unless the displacement signal can be differentiated. E.E.B.

**N66-14165#** United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

**EQUIPMENT FOR THE MAINTENANCE OF HIGH-PURITY ATMOSPHERES IN GLOVE-BOXES**

D. George Aug. 1965 8 p

(AERE-M-1491)

An argon repurification plant capable of maintaining impurity levels at 10–20 parts per million by volume of water vapour and oxygen in a standard glove box is described in detail. Author

**N66-14168#** RCA Service Co., Inc., Camden, N. J.

**A 100 KILOWATT ARC SOURCE FOR SOLAR SIMULATION Technical Documentary Report, Feb.–Sep. 1963**

Arnold Eng. Develop. Center, Jan. 1964 85 p refs

(Contract AF 40(600)-1029)

(AEDC-TDR-64-13; AD-428032) CFSTI: $8.10

An account is given of the results of the 100 kw carbon arc testing program to determine the feasibility of using the high powered arc as a solar simulator source. A carbon arc burning mechanism, capable of operation at power levels in excess of 100 kw, was designed and built. Cored carbons of 25 mm and 35 mm sizes were burned at power levels from 40 to over 100 kw. Satisfactory stability of radiant intensity was obtained at relatively shallow angles between positive and negative electrodes. Polar intensity variations, micro-brightness profiles, spectral distributions and carbon consumption rates were obtained. Author (NSA)

**N66-14244*#** Alabama Univ., University.

**RESEARCH IN THE AEROSPACE PHYSICAL SCIENCES Semiannual Report, Mar. 1–Aug. 31, 1965**

Donald F. Smith et al 1 Nov. 1965 114 p refs

(Grant NsG-381)

(NASA-CR-68765) CFSTI: HC $4.00/MF $0.75 CSCL 20

Space related research undertaken by the main campus departments of mathematics, electrical engineering, chemistry, and physics, and by the Research Institute are summarized. These include studies in such areas as thermodynamics, optimal control, combined nonlinearities, solid state electronics, application of optimization techniques to space problems, solutions of boundary value problems for differential equations, the restricted three-body problem, and the structure and behavior of thin passive films. Research Institute activities centered on mathematics, chemical physics, optics, control sciences and hybrid computation, electromagnetics, communication, fluid mechanics, gas dynamics, heat transfer, and structural mechanics. Data are given on personnel statistics and expenditures, and tabulations are included on the Research Institute contracts, grants, and proposals. Abstracts are also presented on the topics discussed at seminars and lectures, and on papers published by staff members. M.G.J.

**N66-14248#** Atomic Weapons Research Establishment, Aldermaston (England).

**THE SODIUM FLAME PHOTOMETER TEST FOR HIGH EFFICIENCY FILTERS**

V. Dyment and I. D. Thomason May 1965 45 p refs

(AWRE-O-41/65) HMSO: 7s

The sodium flame test was originally devised for testing respirator filters and later extended to large air filters. In this report the use of flame photometry as a filter test is reviewed briefly in relation to the requirements of a test for high efficiency ventilation filters. The basis of the method and experimental examination of the principal features of the design are described. Detailed attention is given to the operating characteristics of the detector unit, and the size distribution of the test cloud. An estimate of the capital and installation costs for one of these rigs is given; it is concluded that the method is satisfactory for testing filters for radioactive installations, and has certain advantages over the other methods considered. Author

**N66-14252#** Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).

**RESEARCH AND FIRST TEST RESULTS IN A GUN TUNNEL [FUNKTIONSUNTERSUCHUNGEN UND ERSTE VERSUCHSERGEBNISSE IM STOSSWELLENWINDKANAL MIT FREIFLIEGENDEM KOLBEN]**

W. Wyborny and H.-P. Kabelitz Jul. 1965 38 p refs In GERMAN; ENGLISH summary

(DLR-FB-65-43; DVL-452) CFSTI: HC $2.00/MF $0.50

The efficiency of a gun tunnel has been confirmed to a larger extent. Test results are shown for shock wave Mach numbers, pressure distribution in the barrel, distribution of Mach number in the test section, and running times. Applicability and limits of the gun tunnel are discussed. Author

**N66-14291*#** Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

**THERMAL ANALYSIS OF A MOBILE LUNAR LABORATORY**

Lawrence Conway and R. Darrel McGinnes Oct. 1964 73 p refs

(Contract NAS8-5289)

(NASA-CR-68980; R-122) CFSTI: HC $3.00/MF $0.75 CSCL 22D

This report describes a thermodynamic analysis and Fortran IV program for calculating the time dependent internal atmospheric temperature within a body which is close to the lunar surface. The body may be of any shape and thermally insulated. The analysis and programs have the capacity to include heat releases inside the body, selective emissivities on the outer surface of the body, any orientation and position on the lunar surface and up to five different temperature-dependent thermal insulations disposed around the body surface. Author

# 12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

**N66-13384** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**STUDYING A SUPERSONIC AIR AND CARBON DIOXIDE FLOW AROUND A SPHERE AT THERMOCHEMICAL EQUILIBRIUM**

G. F. Telenin and G. P. Tinyakov *In its* Rept. of the Acad. of Sci. of the USSR 3 Aug. 1965 p 1–6 refs (See N66-13383 04-34) CFSTI: HC $1.00/MF $0.50

The results of numerical investigations of supersonic air and carbon dioxide flow around a sphere during thermochemical equilibrium are presented. Analytical approximations of thermodynamic functions of gases were used in the calculations. The calculations were made for a wide range of parameters. The difference between the calculated data using approximations methods and the experimental values did not exceed one percent. E.E.B.

**N66-13389** Joint Publications Research Service, Washington, D. C.

**EXPERIMENTAL DETERMINATION OF INERTIA PARAMETERS OF MOVING BODY UNDER WATER**

Kuo-Hua Chao and Yun Chiang *In its* Transl. on Communist China's Sci. and Technol. No. 247 26 Nov. 1965 p 1–47 refs Transl. into ENGLISH from Chung-Kuo Tsao-Ch'uan (Communist China), no. 2, Apr. 1965 p 1–26 (See N66-13388 04-34) CFSTI: $3.00

In this paper, the authors related the experimental determination of inertia parameters of moving bodies under water. The accuracy of the experimental method was first tested with the known inertia parameter of ellipsoids. The error was found to be about 2%. Then, a fin and a rudder were attached to the rotating body for the determination of the inertia parameter of this composite body and its various parts under various phenomena of motion. The authors also proposed theoretical computation formulae for the inertia parameters of the various parts and considered the effects of the interference between the various added parts and the main body. Aside from matters concerning the rudder, the theoretical values coincided satisfactorily with the experimental results. Further study is, however, required for the rudder portion. Finally, the effect of free surface on inertia parameters was discussed, and it was explained in terms of reduction coefficients. The experiment proved that when a body is submerged in water to a depth three times its diameter, the inertia parameter is almost a constant. Author

**N66-13397*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**SATISFACTION OF ASYMPTOTIC BOUNDARY CONDITIONS IN THE NUMERICAL SOLUTION OF BOUNDARY-LAYER EQUATIONS**

Philip R. Nachtsheim and Paul Swigert Washington, NASA, 1965 22 p refs Presented at the 9th Midwestern Mech. Conf., Madison, Wis., 16–18 Aug. 1965

(NASA-TM-X-56756) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A method for the numerical solution of differential equations of the boundary-layer type is presented. The asymptotic boundary conditions are satisfied at the edge of the boundary layer by adjusting the initial conditions so that the mean square error between the computed variables and the asymptotic values is minimized. A least squares convergence criterion is used to propose a method of solution in which the edge of the boundary layer is approached in steps. The convergence rate to a solution is rapid and appears to be insensitive to the initial guesses of the initial conditions. Use of a least-squares convergence criterion leads to the unique solution even in the case of retarded main stream flows. A description of the method is given, and two examples taken from boundary-layer theory are given. Author

**N66-13412*#** Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering.

**CAVITATION HYSTERESIS**

Allen L. Treaster (M.S. Thesis) Jun. 1964 200 p refs

(Grant NsG-85-60; Contract NOrd-16597)

(NASA-CR-62283; AD-438602) CFSTI: HC $5.00/MF $1.25 CSCL 20D

Cavitation hysteresis phenomena in an ultra-high-speed cavitation tunnel with and without test models present, were studied. Observed were the effects of cavitation number, velocity, dissolved air content, characteristic length, cavitation nuclei, pressure history of the liquid, pressure distribution, type of flow, temperature, surface tension, diffusivity, and of other parameters on the formation of cavitation hysteresis. The following three theoretical models were developed to explain cavitation hysteresis: (1) Cavitation bubbles originating from the model surface; (2) cavitation bubbles originating in the free-stream; and (3) cavitation resulting from the random sampling of nuclei in the free-stream. Particles in the tunnel water were sampled and photographed. A plot of dimensionless delay times versus normalized cavitation numbers was made in which data from several models, speeds, and air contents were used. The majority of the tests found that free-stream nuclei were the primary source of cavitation, some cavitation delay times indicated the involvement of surface nuclei. Cavitation delay time increased generally with increasing cavitation number and decrease in air content. It was concluded that the cavitation delay time is more dependent upon exposure pressure than upon exposure time. G.G.

**N66-13434#** Library of Congress, Washington, D. C. Aerospace Technology Div.

**MIXING OF CONCENTRIC HIGH-VELOCITY AIRSTREAMS Surveys of Soviet-Bloc Scientific and Technical Literature**

Seraphim Parandjuk 29 Oct. 1965 28 p Compilation of Abstracts

(ATD-P-65-96)

An annotated bibliography, compiled from Soviet research articles, is presented on the mixing of concentric high velocity airstreams. R.N.A.

**N66-13441#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**STRONG BLOWING IN THE TURBULENT BOUNDARY LAYER**

M. M. Gurfink [1965] 4 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 5, 1965 p 152–153

The turbulent boundary layer for an incompressible fluid flow around a flat plate with very intense transverse blowing is considered. A condition is proposed for determining the laminar sublayer thickness which permits consideration of the direct influence of the blowing. On this basis the concept of strong blowing in a turbulent boundary layer is introduced. R.N.A.

**N66-13450#** Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

**ON THE NON-LINEAR THEORY OF THIN JETS: A PROBLEM IN SINGULAR PERTURBATION**

Robert C. Ackerberg Sep. 1965 40 p refs

(Contract DA-44-177-AMC-91(T))

(PIBAL-888; AD-472247)

The injection of a two-dimensional jet into a uniform stream is considered, the fluids being assumed inviscid and incompressible. When the total head of the jet is much larger than that of the uniform flow the motion is characterized by two disparate

length scales which are the basis for a singular perturbation procedure. Inner and outer expansions are developed for the jet and the external flow. The basic non-linearity introduced by the pressure condition along the vortex sheet separating the jet from the free stream appears as a non-linear boundary condition for the first order outer solution in the external flow. A trivial solution is avoided by specifying a singularity as an inner boundary condition, and the process later justified by matching. The first order outer solution on the jet yields the usual thin jet approximation which is not uniformly valid except for 90 deg injection. A formal variational principle is given for the non-linear potential problem satisfied by the first order outer solution in the external flow. Author (TAB)

**N66-13457#** Virginia Univ., Charlottesville. Dept. of Aerospace Engineering.
**PROJECT SQUID Semiannual Progress Report, 1 Apr.–30 Sep. 1965**
1 Oct. 1965 68 p refs
(Contract Nonr-3623(00); Proj. Squid)
(AD-473565)

Reports of progress during the past 6 months on 13 research programs comprising Project SQUID are presented. The research programs fall into the areas of Fluid Mechanics, Transport and Transfer Processes, Chemical Kinetics, and Combustion Phenomena. Project SQUID is a cooperative program of basic research relating to Jet Propulsion, administered by the University of Virginia and sponsored by the Office of Naval Research. Author (TAB)

**N66-13480*#** National Aeronautics and Space Administration, Washington, D. C.
**HORIZONTAL AND AXISYMMETRIC TRANSITIONAL GAS DYNAMICS AT THE ANTERIOR BORDER OF A STREAMLINED BODY [O RESHINIYAKH PLOSKIKH I OSESIMMETRICHNYKH NESTATSIONARNYKH ZADACH GAZOVOY DINAMIKI V OKRESTNOSTI PEREDNEY KROMKI OBTEKAYEMOGO TELA]**
K. A. Bezhanov Dec. 1965 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 2, 1965 p 168–170
(NASA-TT-F-9455) CFSI: HC $1.00/MF $0.50 CSCL 01A

Solutions are obtained for transitional equations of gas dynamics in horizontal and axisymmetric cases by expanding the desired functions into exponential series by the radius vector. For an arbitrary coefficient of the series we get a system of differential equations with variable coefficients, in which time acts as a parameter. The solution of this system is obtained in a closed form, containing arbitrary time functions which are determined by limit conditions on the shock wave and on the surface of the streamlined body. The obtained results allow calculation of gas flow in the region of the anterior border, or the cross-sectional view of the generatrix of the streamlined body in the case of parameters that do not change rapidly in time. In works [1 – 3] various specific cases of this report had been studied. In work [4] analogous series were used for studying free axisymmetric flows. Author

**N66-13527#** Institut Franco-Allemand de Recherches, St. Louis (France).
**APPLICATION OF THE WITHAM THEORY TO THE INTERACTION OF A SHOCK WAVE AND A PROFILE OF SINUSOIDAL FORM [APPLICATION DE LA THEORIE DE WITHAM A L'INTERACTION D'UNE ONDE DE CHOC ET D'UN PROFIL DE FORME SINUSOIDALE]**
C. Thery 25 Feb. 1963 18 p refs In FRENCH
(ISL-T-4/63) CFSTI: HC $1.00/MF $0.50

A model is described which defines the deformation of an initially straight wave perturbed by the presence of a barrier. After the principle is given, the calculation method is applied in the case of two barriers for which some experimental data had been obtained. The objective sought is (1) to show the agreement and to explain the differences between the theory and experimentation, in the cases where it is possible to substitute the model for actual experimentation; and (2) to recapitulate and to complete experimental results. Transl. by D.T.

**N66-13528#** Institut Franco-Allemand de Recherches, St. Louis (France).
**SEVERAL ORIENTATION EXPERIMENTS FOR A STUDY OF THE DETERIORATION OF A SHOCK WAVE IN A TUNNEL [QUELQUES EXPERIMENTATIONS D'ORIENTATION POUR UNE ETUDE DE LA DEGRADATION D'UNE ONDE DE CHOC DANS UN TUNNEL]**
C. Thery 25 Feb. 1963 40 p In FRENCH
(ISL-1-5/63) CFSTI: HC $2.00/MF $0.50

Various phases of an overall quantitative study on the weakening of shock wave effects are reviewed. Concerning this phenomenon, it is noted that the progressive widening of a tunnel section leads only to moderate losses of shock wave strength. Research is carried out in four areas: (1) the influence of obstacles placed in front of the tunnel entrance; (2) shock wave attenuation in enlarged tunnel sections; (3) shock wave degradation caused by prong shaped obstacles protruding from the tunnel walls; and (4) shock wave weakening caused by wall surface characteristics. Transl. by D.T.

**N66-13530#** Institut Franco-Allemand de Recherches, St. Louis (France).
**FORMULAS AND DIAGRAMS FOR THE CALCULATION OF THE EXPANSION OF REAL GASES IN THE HYPERSONIC SHOCK TUBES PROVIDED WITH BLAST PIPES [FORMELN UND DIAGRAMME ZUR BERECHNUNG DER EXPANSION REALER GASE IN HYPERSCHALLSTOSSROHREN MIT DUSEN]**
H. Oertel 20 Jun. 1963 21 p refs In GERMAN
(ISL-T-10/63) CFSTI: HC $1.00/MF $0.50

Formulas and diagrams for calculations on the stationary isotropic expansion of gas in hypersonic shock tubes with vents are presented. Considered was the gas behavior directly after the impact pressure as well as in the vent at various high Mach numbers. Developed propagation velocities and entropies are shown in graphs. Transl. by G.G.

**N66-13531#** Institut Franco-Allemand de Recherches, St. Louis (France).
**REMARKS ON THE PROPOSITION TO PRODUCE HYPERVELOCITY FLOWS IN TANDEM SHOCK TUBES OF CONSTANT CROSS SECTIONS [BEMERKUNGEN ZUM VORSCHLAG DER ERZEUGUNG VON HYPERSCHALLSTROMUNGEN IN TANDEMSTOSSROHREN KONSTANTEN QUERSCHNITTS]**
H. Oertel 28 Jun. 1963 31 p refs In GERMAN
(ISL-T-12/63) CFSTI: HC $2.00/MF $0.50

A theoretical analysis of stationary and instationary isentropic expansions of hypersonic flows is presented. The application of tandem shock tubes with constant cross sections and two membranes to produce high velocity intensive pressure shocks is evaluated. Transl. by G.G.

**N66-13548#** Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
**NOTES ON A MODIFIED EDDY VISCOSITY AND OTHER PROBLEMS**

E. W. Graham Jun. 1965 18 p refs
(TM-42)

The following topics are discussed: (1) *A Modified Eddy Viscosity*—modification in the incompressible shear flow equation of the eddy flow viscosity; (2) *Momentum Transfer in a Shear Flow*—lateral transfer of streamwise momentum in unsteady shear flow; (3) *The Dissipitation of Energy in Mixing Length Theory*—momentum transfer of fluid particles in turbulent velocities; and (4) *Trajectories of Particles in a Shear Flow*—force relations and trajectories of fluid particles. G.G.

**N66-13562*#** Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

**ANALYSIS OF TWO-DIMENSIONAL, UNSTEADY FLOW IN A PROPELLANT TANK UNDER LOW GRAVITY BY FINITE DIFFERENCE METHODS**

Carl T. K. Young Oct. 1965 21 p refs
(Contract NAS8-20073)
(NASA-CR-68656; R-164) CFSTI: HC $1.00/MF $0.50 CSCL 20D

This report describes a numerical procedure for solving a two-dimensional, unsteady flow problem. The fluid is in a tank, has a free surface, a periodic source (to be terminated) on the side of the tank, and is subject to a near zero gravitational field. The flow is assumed to be incompressible and irrotational so that the problem reduces to a boundary value problem governed by the Laplace equation. Author

**N66-13564*#** Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

**HYDROSTATICS OF A FLUID BETWEEN PARALLEL PLATES AT LOW BOND NUMBERS**

Frederick W. Geiger Oct. 1965 44 p refs
(Contract NAS8-20073)
(NASA-CR-68658; R-159) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The hydrostatics of a fluid between parallel plates at low but positive Bond numbers is re-examined as a preliminary to dynamic calculations. The results of this study differ from those of a previous study by Reynolds. It is believed that the results of Reynolds are in error. Author

**N66-13575#** General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

**TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Third Quarterly Progress Report, Apr. 26–Jul. 25, 1965**

Aug. 1965 28 p refs
(Contract AT(04-3)-189)
(GEAP-4933)

An instrument is being built for the semi-local measurement of liquid film flow rate. The annular test section is being modified to accommodate an eccentrically positioned rod. A nine-rod test section is being designed with provision to facilitate flow structure measurement. Pressure drop and average test section void data for two-phase upflow of air and water at 100 psia in both the round tube and concentric annulus are in good agreement with the Lockhart-Martinelli correlation. Measurements made with the isokinetic sampling probe for single-phase air and single-phase water are within about 5 percent of a theoretical curve based upon prediction of inlet pressure drop for laminar flow in the sampling probe. For two-phase flow measurements, a continuous purge will be used in the static pressure lines of the sampling probe setup. A detailed profile investigation of low-quality (6.7 percent), two-phase flow in a round tube, by means of the sampling probe, shows that the maximum impact pressure does not occur on the tube centerline in spite of the expected smooth distributions of local quality and void fraction across the tube. Thirty-eight CHF data points were obtained using the nine-rod test section with a 60-inch heated length, at test conditions of 1000 psia and 0.5, 0.75, 1.0, and 1.25 M lb/h-ft$^2$. Qualities at the CHF ranged from 14 to 42 percent. Author

**N66-13702#** General Dynamics/Astronautics, San Diego, Calif.

**CALCULATION OF STEADY, THREE-DIMENSIONAL SUPERSONIC FLOW-FIELD BY A FINITE DIFFERENCE METHOD**

Hans U. Thommen and Leonardo D'Attore [1964] 34 p refs
(GDC-ERR-AN718)

The application of the Lax–Wendroff conservation difference scheme to steady, two- and three-dimensional supersonic flow fields is considered. It is found that in general this scheme gives such large oscillations in the tail ends of shock waves that it is difficult to interpret the results with any degree of accuracy. Consequently, a slightly modified difference scheme is studied. This scheme provides excellent damping in the shock regions, but increases the truncation error in the smooth portions of the flow field. Also, the step size has to be chosen slightly smaller for reasons of stability. The numerical examples presented demonstrate, however, that the method yields useful data and that the truncation error in the smooth portions of the flow are tolerable. The calculations assume the gas to be perfect with constant specific heats and the effects of all transport properties are neglected. Author

**N66-13772#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

**INTERACTION OF A DISTRIBUTED SURFACE VIBRATION WITH AN ADJACENT STEADY FLUID FLOW Interim Technical Report No. 2**

Manfred A. Heckl and Francis J. Jackson 13 Sep. 1965 37 p refs
(Contract Nonr-3944(00))
(Rept.-1291; AD-622588) CFSTI: HC $2.00/MF $0.50

An analysis is presented describing, in an idealized manner, the oscillatory flow field generated in viscous fluid supported by a flat plate, when the plate surface is excited into a transverse standing wave pattern by external means. The analysis proceeds to include the influence of a constant D.C. flow on the oscillatory fluid motion for the case of both standing and travelling surface waves. The ultimate aim of such studies has been to ascertain whether or not the transition of a laminar flow into turbulent flow could be delayed by active excitation of the boundary; or whether or not such oscillation can modify the turbulent flow field should transition occur. An attempt is made to include the effects of the steady flow boundary layer profile on the total flow field, by a piecewise superposition of adjacent constant velocity layers of increasing magnitude as the distance from the boundary increases. This idealized model suggests qualitatively the conditions under which amplification of the boundary layer disturbances produced by the vibrating surface may occur, as they are transmitted through a steady flow boundary layer. Author (TAB)

**N66-13828*#** United Aircraft Corp., East Hartford, Conn.

**EXPERIMENTAL INVESTIGATION OF PERIPHERAL-WALL INJECTION TECHNIQUES IN A WATER VORTEX TUBE**

Arthur Travers Sep. 1965 50 p refs
(Contract NASw-847)
(NASA-CR-68866; D-910091-7) CFSTI: HC $2.00/MF $0.50 CSCL 20D

An experimental investigation was conducted to determine the effects of the peripheral-wall injection technique used to drive a water vortex on the structure and thickness of the turbulent mixing region near the peripheral wall and on the flow patterns in the primary-flow region outside the peripheral and end-wall boundary layers. Three 10-in.-diameter lucite vortex tubes having three different peripheral-wall injection configurations were tested: (1) tangential injection through a single 0.205-in.-high slot extending the entire 30-in. length of the tube, (2) tangential injection through four 0.050-in.-high slots, and (3) approximately tangential injection through 2144 ports of 0.060-in. diameter. In most tests, a controllable quantity of fluid was removed through one or more perforated screens in the peripheral wall, and the remainder of the fluid was removed through 0.938-in.-diameter thru-flow ports located at the centers of the two end walls. However, a few tests were conducted in which no fluid was removed through the thru-flow ports; instead, fluid was injected through a 1.0-in.-diameter porous tube located along the centerline of the vortex tube. Author

**N66-13835*#** United Aircraft Corp., East Hartford, Conn.
**EXPERIMENTAL INVESTIGATION OF THE EFFECT OF PERIPHERAL-WALL INJECTION TECHNIQUE ON TURBULENCE IN AN AIR VORTEX TUBE**
David J. Mc Farlin Sep. 1965 49 p refs
(Contract NASw-847)
(NASA-CR-68867; 0-910091-5) CFSTI: HC $2.00/MF $0.50
CSCL 20D

Experiments were conducted to investigate the effect of the peripheral-wall injection technique used to drive an air vortex on the level of turbulence in the vortex. In one configuration, air was injected tangentially through a single 0.182-in.-high slot which extended along the entire 30-in. length of the tube. In a second configuration, air was injected approximately tangentially through 2144 ports of 0.060-in. diameter distributed over the surface of the peripheral wall. In both tubes, a controlled quantity of air was removed through ports located at the centers of the two end walls, or was injected through a porous tube located on the centerline of the vortex; air was also removed through perforated plates in the peripheral wall. Hot-wire-anemometer measurements of tangential velocity profiles and root-mean-square velocity fluctuations were made near the peripheral wall at three circumferential stations at one axial location (the axial midplane). The results indicate that the interior region of low-turbulence flow is larger for the 2144-port configuration than for the single-slot configuration. This is primarily because the turbulent peripheral wall boundary layer is thinner for the 2144-port configuration. Author

**N66-13881#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**RESULTS OF COMPUTING THE BOUNDARY LAYER ON BLUNT CONES IN A SUPERSONIC FLOW**
A. L. Ankudinov [1965] 8 p refs Transl. into ENGLISH from Vychislitel'naya Mat. i Mat. Fiz. (USSR), v. 5, no. 5, 1965 p 960–965

Results are presented of computations made on the boundary layer of spherically blunt cones in a supersonic air flow for a constant wall temperature and for a heat insulated wall. R.N.A.

**N66-13885#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**PASSAGE THROUGH SINGULARITIES IN THE NUMERICAL SOLUTION OF PROBLEMS OF SUPERSONIC FLOW AROUND BODIES**
Iu. P. Lun'kin, F. D. Popov, T. Ia. Timofeeva, and Iu. M. Lipnitzkii [1965] 6 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 248, 1965 p 7–13

The problem of supersonic flow around bodies reduces to a system of nonlinear partial differential equations of mixed type. Two approximation schemes have been developed for analyzing the shock layer. In the first scheme the functions across the shock layer are approximated, and in the second scheme the functions along the shock layer are approximated. The presence of saddle-type singular points in the first scheme approximations leads to difficulties in the numerical solution. An approximating system for this first scheme which contains no singular points is proposed. This system may be integrated numerically to any previously assigned degree of accuracy in the whole shock layer, including the transition region of subsonic into supersonic flow. The proposed system is particularly convenient for analyzing nonequilibrium flows. R.N.A.

**N66-13886#** RAND Corp., Santa Monica, Calif.
**ELABORATION OF HOCKING'S HYDRODYNAMIC THEORY**
C. L. Olson Sep. 1965 117 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4715-PR; AD-620896) CFSTI: HC $4.00/MF $0.75

As a step towards a definitive solution of the collision efficiency problem of two spheres falling in a viscous medium, L. M. Hocking's unpublished Ph.D. thesis (University of London, 1958) is examined. The resulting infinite sets of equations that must be solved for the forces on the spheres are found to be correct. This memorandum shows, however, that Hocking's solution of these equations have large errors if the spheres are close together. A suitable method for solving the equations is developed, as is a procedure for accurately determining the errors. Author (TAB)

**N66-13933#** Pratt and Whitney Aircraft, Middletown, Conn.
**DISSERTATION OF JET PUMP ANALYSIS**
D. P. Daley 18 Jun. 1965 101 p refs
(Contract AT(30-1)-2789)
(TIM-913) CFSTI: HC $4.00/MF $0.75

The existing experimental data taken at CANEL are evaluated and compared with those from other sources. An extensive design procedure is discussed to optimize a jet-centrifugal pump combination under specific constraints. The analysis is made general in that it applies to various cases involving different initial assumptions. By a number of iterative steps, these assumptions are validated. The result is a completely sized jet pump and its corresponding dimensionless head-flow and efficiency curves. Finally, the results of the theoretical development are compared with the existing experimental data. Using the CDC computer program, the following conclusions are drawn concerning the theoretical development: (1) the theory behind the numerical method is excellent in predicting a jet pump performance curve; (2) it is good for low to medium flow rates (with respect to the design point–260 gpm) for the individual components; and (3) it is pessimistic in its prediction of values for the individual components at high flow rates. The theory, when it comes to predicting the various friction factors, leaves much to the conjecture of the designer. It is realized that this is not desirable, yet presently the numerical method is the most accurate and consistent in development. Additional testing of the jet pump, particularly at different area ratios, would aid in developing a better over-all design. Author (NSA)

**N66-13941#** Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
**SOME COMMENTS ON INSTRUMENTATION FOR WAKE FLOW STUDIES AND OTHER GAS DYNAMIC EXPERIMENTS**

E. A. Brown and G. J. Mullaney Jun. 1965 11 p refs
(TM-43)

Exotic instruments which do not disturb the flow are discussed relative to making measurements in wake flow and gas dynamics experiments. Seven techniques are tabulated and recommended for further development as measuring devices. The table shows the quantities which each measures, advantages and disadvantages, and an ordering according to their development status. These techniques are listed as Schlieren sensitivity augmentation, glow discharge probe, microschlieren/interferometer, resonance radiation/electron beam, motion of a spherical sound wave, drag on sphere probe, and use of micron size tracer particles. A general discussion is included for each, relative to its area of application. C.T.C.

**N66-13993#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**ON THE ROTATIONAL MOTION OF A SPHERE IN A HIGH-SPEED RAREFIED FLOW**

Nam Tum Po [1964] 7 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 13, 1964 p 162–167

Solutions to equations describing the braking effects on a sphere rotating in a high-speed rarefied gas flow are presented. The force acting on a plate of area S moving with velocity V in a rarefied gas, with the plate being inclined at an angle $\theta$ to the direction of the velocity is considered. A geometrical diagram of the sphere is set up, and problems relating to the motion of the sphere relative to the center of mass; to the stream velocity relative to the sphere area; and to the air drag effect on the braking moment are considered. Euler equations of motion are considered for the sphere tilted at different angles during its rotation. L.S.

**N66-14054*#** National Aeronautics and Space Administration, Washington, D. C.

**EFFECT OF RAREFACTION ON THE PROCESSES OF GAS-DYNAMIC FRICTION DURING BLOWING OR SUCTION THROUGH THE WALL ADJACENT TO THE FLOW [K VOPROSU O VLIYANII RAZREZHENIYA NA PROTSESSY GAZODINAMICHESKOGO TRENIYA PRI NALICHII VDUVA ILI OTSOSA GAZA CHEREZ OMYVAYEMUYU POTOKOM STENKU]**

Yu. A. Koshmarov Jan. 1966 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 6, 1964 p 48–54
(NASA-TT-F-406) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The author discusses the problem of the flow of a rarefied gas between two porous plates that move at a small relative velocity. The analysis is based on the molecular concepts of a gas. Expressions are derived for calculating the velocity fields and fields of frictional stresses; these expressions are shown to be valid for any degree of rarefaction. Author

**N66-14069#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.

**ANNUAL PROGRESS REPORT, 1965**

Oct. 1965 217 p refs

Research was conducted on the following topics: mechanics of rarefied gases; plasma dynamics; hypersonic gasdynamics and blast wave phenomena; energy conversion; aerodynamic noise; subsonic aerodynamics; aerospace flight dynamics; materials science and structures; upper atmosphere research; molecular beams and surface interactions; and industrial and architectural aerodynamics. R.W.H.

**N66-14084#** France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux.

**OUTLINE ON THE EXPERIMENTAL POSSIBILITIES OF THE O.N.E.R.A. HYDRODYNAMIC TUNNEL FOR VISUALIZATION [APERCU SUR LES POSSIBILITES EXPERIMENTALES DU TUNNEL HYDRODYNAMIQUE A VISUALISATION DE L'O.N.E.R.A.]**

H. Werlé Nov. 1958 39 p refs In FRENCH
(TN-48) CFSTI: HC $2.00/MF $0.50

A hydrodynamic tunnel for the visualization of low velocity flows is described and some of its applications in theoretical and experimental aerodynamics are discussed. The conditions are given for the tunnel's operation and utilization, and both proceeding and proposed experiments are reported.

Transl. by D.T.

**N66-14116*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**PRIMER OF RAREFIED GAS FLOW**

Barry Yaffe *In its* Goddard Summer Workshop Program [1964] 24 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

This primer attempts to present a sketch of the behavior of rarefied gases and a synopsis of the analytical tools employed in their study. Because the subject of rarefied gas flow draws heavily upon classical fluid mechanics and the kinetic theory of gases, we must take time at the outset to establish a common fund of knowledge composed of pertinent concepts from these areas of study. Then we will be in a position to discuss rarefied gas phenomena usefully. Author

**N66-14211#** RAND Corp., Santa Monica, Calif.

**THE EFFECT OF THE MOLECULAR MODEL ON RAREFIED GAS FLOWS**

D. Roger Willis Nov. 1965 43 p refs
(Contract AF 49(638)-66-C-0001)
(RM-4638-PR; AD-623607) CFSTI: HC $2.00/MF $0.50

The memorandum presents an analysis of the effect of molecules with infinite collision cross section upon the methods of obtaining solutions to the Boltzmann equation in the nearly free molecular regime. It is found that Knudsen iteration is satisfactory for computing physically meaningful moments of the distribution function for three dimensional flows about isolated bodies. For one dimensional (parallel-plate) problems a new iterative method is proposed. It is found that certain of the moments (e.g., the mean velocity perturbations) will have the form $(1/Kn)$ to the $(S-1)(S+1)$ power for molecules that repel each other with a force proportional to the inverse-S power of their separation. For flows about two-dimensional isolated bodies, significant questions appear to be still open. The effect os using the correct quantum collision cross section also requires further study. Author (TAB)

**N66-14215#** Royal Aircraft Establishment, Farnborough (England).

**ON THE ORIGIN OF VORTICES IN AN IDEAL FLUID. PART IV: AND RELEVANT APPENDICES OF A LECTURE [UBER DIE ENTSTEHUNG VON WIRBELN IN DER IDEALEN FLUSSIGKEIT MIT ANWENDUNG AUF DIE TRAGFLUGELTHEORIE UND ANDERE AUFGABEN]**

L. Prandtl Aug. 1965 17 p Transl. into ENGLISH from the book "Vortrage aus dem Gebifte der Hydro- und Aerodynamik" Berlin, Springer, 1924 p 23–35, 27–33
(RAE-LIB-TRANS-1099) CFSTI: HC $1.00/MF $0.50

Two-dimensional, inviscid, irrotational, incompressible flows in which the tangential velocity vector is discontinuous across certain surfaces, vortex sheets, are sought. Two types of flow are found. In the first the vortex sheet, an equiangular spiral, remains fixed in space, though the circulation associated with it, like the entire velocity field, increases without limit as the time increases towards a value which bounds the range of validity of the solution. The second is consistent with the flow field produced by a wedge at a large distance from its apex. Again the discontinuity surface is an equiangular spiral, whose inclination is uniquely related to its rate of growth with time. Not all rates of growth are possible. Author

**N66-14234#** Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

**A REVIEW OF THEORETICAL METHODS RELATED TO BOUNDARY LAYER CONTROL BY BLOWING**

Beverly J. Graham Apr. 1965 83 p refs

(TM-40)

Methods for calculating the blown boundary layer problem are surveyed, and the fundamental equations and assumptions used in various solutions are reviewed. Also listed are the approximations which reduce the general equations describing the properties of a gas in motion to the equations for incompressible, two-dimensional boundary layer flow over surfaces of small curvature. The differences and similarities existing between the ordinary boundary layer problem and one with jet blowing are emphasized. Theoretical work on problems involving jet blowing over, or adjacent to, solid boundaries is described. Several methods are examined to clarify the nature of certain assumptions, and to show the unsatisfactory and highly empirical state of some analytical procedures. The need for improved understanding of the jet mixing process is pointed out, and a satisfactory definition of eddy viscosity is identified as the most difficult step in obtaining a solution to the problem. M.G.J.

**N66-14237*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**CONDENSATION PRESSURE DROP OF NONWETTING MERCURY IN A UNIFORMLY TAPERED TUBE IN 1-g AND ZERO-GRAVITY ENVIRONMENTS**

James A. Albers and Robert P. Macosko Washington, NASA, Jan. 1966 40 p refs

(NASA-TN-D-3185) CFSTI: HC $2.00/MF $0.50 CSCL 20D

An experimental investigation was conducted to determine the pressure drop of nonwetting (dropwise) condensing flow of mercury vapor in 1-g and zero gravity environments. Local static pressure data were obtained for a uniformly tapered stainless steel horizontal tube for various flow rates, pressures, and condensing lengths. The overall static pressure difference from inlet to interface varied from a pressure rise of 0.9 pound per square inch to a pressure drop of 0.1 pound per square inch, while the overall total pressure drop varied from 0.0 to 1.4 pounds per square inch for the condensing lengths and flow rates investigated. Experimental data indicated that the gravity effect was negligible for all flow rates investigated. Experimental values of the fog flow parameter varied between −50 and +100 percent of the theoretical value for Weber numbers ranging from 10 to 100 (high velocity region). For Weber numbers ranging from 0.1 to 10 (low velocity region) the experimental values varied between −50 and +165 percent of the theoretical value. Author

**N66-14257#** General Electric Co., Philadelphia, Pa. Missile and Space Div.

**THE FLOW OF A CHEMICALLY REACTING GAS MIXTURE**

F. G. Gravalos 28 Feb. 1963 43 p refs

(DOC.-63SD200, Vol. 1)

This work provides the general formulation of the flow of a reacting gas mixture under three fundamental hypotheses: (1) the heat conduction and diffusion are zero; (2) all the components and the mixture obey the laws defining ideal gases; and (3) the flow is axially symmetric. Author

# 13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

**N66-13339*#** Stanford Univ., Calif. Radioscience Lab.

**ION DISTRIBUTION AND TEMPERATURE IN THE TOPSIDE IONOSPHERE OBTAINED FROM THE ALOUETTE SATELLITE**

Theodore M. Watt [1965] 37 p refs

(Grants NsG-30-60; NGR-05-020-089)

(NASA-CR-68611) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Electron density distributions are obtained from Alouette topside soundings recorded at Stanford University. Plasma scale height profiles are then determined, and from these profiles information can be deduced about relative ion concentrations, electron temperature and ion temperature. Results are obtained for dip latitudes between 48° N and 78° N, and altitudes from 400 km to 900 km. It is found that the lower latitude nighttime data can be interpreted in terms of a three-constituent ($O^+$, $H_e^+$, $H^+$) diffusive equilibrium model with an ($O^+$) – ($H_e^+$, $H^+$) transition occurring at about 550 km in the summer and 500 km in the winter. The variation of this transition altitude with local time and with latitude is obtained. It is found that the transition level rises with increasing latitude, rising above 900 km at about 62° dip latitude. The transition level is also observed to rise very quickly at local sunrise and to descend quickly at local sunset. The data suggest that the ($O^+$) – ($H_e^+$, $H^+$) transition is at least as high as 1000 km during the day. Under these conditions the daytime scale heights at all observed latitudes and the nighttime scale heights at dip latitudes north of 63° can be interpreted in terms of temperature variations in an $O^+$ ionosphere. Author

**N66-13343** Library of Congress, Washington, D. C. Aerospace Technology Div.

**DEVELOPMENTS IN SOVIET TWILIGHT RESEARCH**

Daniel W. Michaels *In its* Foreign Sci. Bull., Vol. 1, No. 10 Oct. 1965 p 14–17 refs (See N66-13340 04-34)

Twilight phenomena serve both as indicators of the optical properties of the terrestrial atmosphere and of the intrusion of cosmic dust. Twilight investigations from satellites have been proposed as a promising means of analyzing planetary atmospheres in general. Author

**N66-13390** Joint Publications Research Service, Washington, D. C.

**STUDIES ON ATMOSPHERIC CIRCULATION IN THE STRATOSPHERE AND THE EFFECT OF SOLAR ACTIVITY ON ATMOSPHERIC CIRCULATION**

*In its* Transl. on Communist China's Sci. and Technol. No. 247 26 Nov. 1965 p 48–53 Transl. into English from the monograph "P'ing-Liu-Ts'eng Ta-ca'i Huan-liu chi T'ai-yang Huo-tung tui Ta-ch'i Huan-liu Ying-hsiang te yen-chiu (See N66-13388 04-34) CFSTI: $3.00

This collection of papers is a conclusion of research made by various workers on atmospheric circulation in the stratosphere and the effect of solar activity on atmospheric circulation during the last two years. Two papers discuss chiefly theoretical research on the interrelationship of atmospheric circulation in the stratosphere and that in the troposphere. Three papers cover studies in meteorology mainly, including some factual meteorological analysis of seasonal changes in the atmospheric circulation in the middle and lower layers of the stratosphere, and the interaction of the stratosphere and the troposphere with each other. Five papers concentrate mostly on statistical analysis studies of the effect of unusual solar radiation on the stratosphere and troposphere. Through these studies, the authors have indicated the close relationship between the atmospheric circulation in the stratosphere and troposphere, and the marked influence of unusual solar radiation on temperature changes in the stratosphere as well as circulation pattern changes in the troposphere. Author

**N66-13401#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 241**

22 Nov. 1965 29 p refs Transl. into ENGLISH from K'o Hsueh Tung Pao (Peking), no. 10, Oct. 1965 p 847–852 (JPRS-32953; TT-65-33530) CFSTI: $2.00

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1. INFLUENCE OF CHAIRMAN MAO'S TEACHING ON METEOROLOGICAL RESEARCH WORK Chi-p'ing Chao p 1–14

2. DEVELOPMENT OF METEOROLOGY IN RECENT YEARS Tu-cheng Yeh p 15–25 (See N66-13402 04-20)

**N66-13420** Joint Publications Research Service, Washington, D. C.

**A NUMERICAL EXPERIMENT OF THE GENERAL CIRCULATION OF THE ATMOSPHERE**

Hsiung-Shan Ch'en *In its* Transl. on Communist China's Sci. and Technol., No. 233 5 Nov. 1965 p 1–32 refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v.34, no. 4, Nov. 1964 p 443–460 (See N66-13419 04-34) CFSTI: $3.00

A two-level quasi-geotropic numerical experimental model of the general circulation of the atmosphere is constructed herein by including the dynamic effects of topography and heating. The influences of clouds on long-wave and short-wave radiations are considered by assuming that the presence of cloud depends only on the velocity of the vertical current. A surface simulating the actual topography and land-and-sea distribution of the Northern Hemisphere is placed in the model, and the surface temperature is obtained by solving the heat-transfer equation. The derived non-linear ordinary differential equations are numerically integrated on an electronic computer by using the Runge-Kutta method. In the experiment the surface temperature shows apparent seasonal fluctuations, which lag behind the fluctuation of short-wave solar radiation by about one month. The basic currents also show apparent seasonal fluctuations, which also lag behind the fluctuation of short-wave solar radiation by over one month. Under the mutual effects of topography and non-adiabatic heatings, troughs form over eastern Asia and northern America in winter. Author

**N66-13477*#** National Aeronautics and Space Administration, Washington, D. C.

**THE UNDERGROUND GEOPHYSICAL STATIONS AND THE HORIZONTAL PENDULUMS OF THE OBSERVATOIRE ROYAL DE BELGIQUE**

J. Verbaandert and P. Melchior Dec. 1965 167 p Transl. into ENGLISH of "Les Stations Geophysiques Souterraines et les Pendules Horizontaux de l'Observatoire Royal de Belgique" Belgium, Observatoire Royal de Belgique, Monograph No. 7, 1961

(NASA-TT-F-8782) CFSTI: HC $5.00/MF $1.00 CSCL 08K

This paper describes the underground geophysical stations of the Belgium Royal Observatory, the construction and design of the horizontal pendulum used to measure vertical deviations in the terrestrial tide, and some of the numerical findings recorded by the pendulum. A harmonic analysis of these recordings, an outline for their geophysical interpretation, and new research being conducted in this field are discussed. R.N.A.

**N66-13486*#** National Aeronautics and Space Administration, Washington, D. C.

**INVESTIGATION OF THE POLAR AURORAE, GEOMAGNETIC DISTURBANCES, AND THE IONOSPHERE AT HIGH LATITUDES**

S. I. Isayev, ed. Dec. 1965 81 p refs Transl. into ENGLISH of "Issledovaniye Polyarnykh Siyaniy, Geomagnitnykh Vozmushcheniy i Ionosfery v Vysokikh Shirotakh" Moscow, "Nauka" 1965

(NASA-TT-F-388) CFSTI: HC $3.00/MF $0.75 CSCL 04A

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1. THE DIURNAL MARCH OF IONOSPHERIC WIND VELOCITY IN THE ZONE OF POLAR AURORAE AND $S_D$-VARIATION M. I. Pudovkin p 1–8 refs (See N66-13487 04-13)

2. MORPHOLOGY OF HYDROGEN EMISSION IN POLAR AURORAE L. S. Yevlashin p 9–13 refs (See N66-13488 04-13)

3. SOME FEATURES OF THE LATITUDE DRIFT OF POLAR AURORAE L. N. Mal'ko p 14–20 refs (See N66-13489 04-13)

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7. DETERMINATION OF THE PARAMETERS OF THE DISTURBED IONOSPHERE IN THE ZONE OF POLAR AURORAE M. I. Pudovkin p 47–51 refs (See N66-13493 04-13)

8. BACK-SCATTER SOUNDING OF THE IONOSPHERE AT MURMANSK G. P. Tsirs p 52–61 refs (See N66-13494 04-13)

9. MUTUAL POSITION OF THE CURRENT $S_D$-VORTICES AND THE MAIN ZONE OF POLAR AURORAE N. S. Smirnov p 62–69 refs (See N66-13495 04-13)

10. RESULTS OBTAINED FROM INVESTIGATIONS OF THE $S_D$-VARIATIONS IN HIGH LATITUDES G. A. Loginov p 70–78 refs (See N66-13496 04-13)

**N66-13487*** National Aeronautics and Space Administration, Washington, D. C.

**THE DIURNAL MARCH OF IONOSPHERIC WIND VELOCITY IN THE ZONE OF POLAR AURORAE AND $S_D$-VARIATION**

M. I. Pudovkin *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 1–8 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The diurnal march of the ionospheric wind in the auroral zones and the mechanism of excitation of the $S_D$-variation, possibly caused by electric currents due to the dynamo action of the wind, are investigated by measuring the displacement of electric currents responsible for the magnetic bays. The $S_D$-variation is found to depend on the curve of the normal wind velocity component ($V_t$) and on the diurnal course of auroral intensity and can be defined (in relative units) by multiplying these two parameters. Author

**N66-13488*** National Aeronautics and Space Administration, Washington, D. C.

**MORPHOLOGY OF HYDROGEN EMISSION IN POLAR AURORAE**

L. S. Yevlashin *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 9–13 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The emission of hydrogen $H_\alpha$ at an intensity of not less than 150 Rayleighs in polar aurorae is correlated to the presence of a sporadic $E_s$ layer, showing more intense emission at a relatively low critical frequency ($f_0E_s$ = 4 to 5 Mc) of this layer. No correlation was found between hydrogen emission and ionosphere parameters in the F layer. Apparently, de-excitation of protons connected with the aurorae takes place primarily at low altitudes (110 to 130 km). Author

**N66-13489*** National Aeronautics and Space Administration, Washington, D. C.

**SOME FEATURES OF THE LATITUDE DRIFT OF POLAR AURORAE**

L. N. Mal'ko *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 14–20 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The latitude drift of polar aurorae is plotted against local time, on the basis of camera recordings at Russian and Alaskan Arctic stations. The pattern of auroral motion proceeds over geomagnetic latitudes and is influenced by magnetic field disturbances, shifting farther south at greater disturbances. The belt shifts southward in the evening, shows a variation in width during the night, and moves northward again at daybreak, at a total drift of 10 to 15° and a rate of displacement up to 1000 m/sec. Author

**N66-13490*** National Aeronautics and Space Administration, Washington, D. C.

**THE ORIENTATION OF HOMOGENEOUS ARCS OF POLAR AURORAE AND THEIR CORRELATION WITH THE CURRENTS OF MAGNETIC DISTURBANCES**

V. K. Roldugin and G. V. Starkov *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 21–31 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The diurnal march of azimuths and the position of the auroral arcs, oriented along the spiral of maximum probability of appearance of aurorae, are discussed in their relation to magnetic disturbances over the polar cap, using plottings based on photographs obtained with an all-sky camera. Most arcs are grouped about the night spiral, showing two maxima of appearance, of $R_{max}$ 550 and 1100 km. At local geomagnetic midnight, the arcs make a large angle with the currents of magnetic disturbances, but are parallel before and after. Author

**N66-13491*** National Aeronautics and Space Administration, Washington, D. C.

**ZONE OF INTRUSION OF THE CORPUSCULAR FLUX AND THE SPIRAL DISTRIBUTION OF THE MAXIMUM PERTURBATION TIME**

A. B. Korotin *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 32–37 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The position and configuration of the target zone of the corpuscular stream, relative to the spiral distribution of geomagnetic disturbance, are defined on the basis of data obtained at 30 points with known geomagnetic coordinates in the polar zone during passage of the auroral ring. The position of the zone depends largely on the intensity of disturbance, showing a closer approach to the Pole at weaker disturbances. An attempt is made to prove that the target zone has a nearly circular shape. Author

**N66-13492*** National Aeronautics and Space Administration, Washington, D. C.

**SHORT-PERIOD FLUCTUATIONS IN THE FLOW INTENSITY OF POLAR AURORAE AND THEIR ASSOCIATION WITH GEOMAGNETIC PULSATIONS**

R. G. Skrynnikov and V. P. Selivanov *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 38–46 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

Short-period fluctuations in auroral brightness in their correlation with geomagnetic pulsations are calculated on the basis of electrophotometer (180°) recordings of auroral flashes in integral light and in the emissions of λ 3914 Å and λ 5577 Å. Comparison with simultaneously recorded pulsations of the geomagnetic field, at a scanning rate of 12 and 20 mm/min, showed characteristic fluctuations of 4 to 8 sec period with a shortening of the mean period toward the morning hours (local time). The mean diurnal march of the amplitudes showed an evening maximum at 1900 GMT and a midnight maximum at 2300 GMT. The correlation between auroral flashes and geomagnetic pulsations is explained on the basis of the dynamic theory of ionospheric winds. Author

**N66-13493*** National Aeronautics and Space Administration, Washington, D. C.

**DETERMINATION OF THE PARAMETERS OF THE DISTURBED IONOSPHERE IN THE ZONE OF POLAR AURORAE**

M. I. Pudovkin *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 47–51 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

Ionosphere anomalies and their influence on the intensity of polar aurorae, were investigated by studying the absorption of cosmic radioemission during geomagnetic storms at a frequency of several tens of megacycles. Formulas are derived for calculating the absorption of radio noise, linear density of the ionospheric electric current, and the intensity of magnetic disturbance to demonstrate the close correlation of magnetic disturbance and brightness of auroral display. Author

**N66-13494*** National Aeronautics and Space Administration, Washington, D. C.

**BACK-SCATTER SOUNDING OF THE IONOSPHERE AT MURMANSK**

G. P. Tsirs *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 52–61 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The method of ionosphere sounding by back-scattering of short waves from the earth's surface is reviewed and applied to determine the skip zone of various ionosphere layers under both summer and winter conditions. Perturbations of the ionosphere were measured from distances of up to 2000 km, thus permitting a fairly accurate determination of the maximum usable frequency for radio communication. Auxiliary use of vertical soundings at certain control points of the route is recommended for cases of several reflecting layers. Author

**N66-13495*** National Aeronautics and Space Administration, Washington, D. C.

**MUTUAL POSITION OF THE CURRENT $S_D$-VORTICES AND THE MAIN ZONE OF POLAR AURORAE**

N. S. Smirnov *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Altitudes Dec. 1965 p 62–69 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

The current system responsible for the mean $S_D$-variation over the earth's surface was constructed on the basis of magnetic data from 16 observatories located in the auroral zone and on the polar cap. The position of the central electrojet of the system is compared with the position of the main auroral zone. The corpuscular target zone, corresponding to the position of the electrojet of the $S_D$-vortex, exists statistically as an integral whole and is closely linked with the earth's surface. No closed current ring, corresponding to the closed auroral ring, was detected. Author

**N66-13496*** National Aeronautics and Space Administration, Washington, D. C.

**RESULTS OBTAINED FROM INVESTIGATIONS OF THE $S_D$-VARIATIONS IN HIGH LATITUDES**

G. A. Loginov *In its* Invest. of the Polar Aurorae, Geomagnetic Disturbances, and the Ionosphere at High Latitudes Dec. 1965 p 70–78 refs (See N66-13486 04-13) CFSTI: HC $3.00/MF $0.75

Previous investigations of the $S_D$-variations in high latitudes are extended to include studies of the rotation of the horizontal vector of disturbance on northward shift of the auroral zone at decreasing solar activity. Plottings of the diurnal march of the disturbance vector, in both the horizontal and vertical plane, show that the horizontal vector remains approximately parallel to itself, along the geographic meridian. Reversal of the direction takes place counterclockwise over Murmansk and clockwise over Uellen. The general direction is determined by the direct dynamo action of the ionospheric wind and by the electrostatic field at the junction of eastern and western electrojets. Differences in degree of rotation in 1958 and 1961 indicate that the auroral zone shifts northward with decreasing solar activity. Author

**N66-13566*#** Southwest Center for Advanced Studies, Dallas, Tex.

**THE MULTIPLE IONOSPHERIC PROBE Auroral Ionospheric Report**

W. J. Heikkila, ed., R. L. Bickel, N. Eaker, J. A. Fejer, R. H. Morgan et al Aug. 1965 67 p refs Prepared jointly with Central Propagation Lab.

(Contract NSR-44-004-017)

(NASA-CR-68644; DASS-65-2) CFSTI: HC $3.00/MF $0.75 CSCL 04A

The report constitutes a brief description of a multiple ionospheric probe Nike Apache rocket payload. This payload includes five different types of probes. One of these, called the resonance relaxation probe, is designed to detect plasma resonances of the types seen on top-side sounder records. A second measurement is that of the impedance of a sphere as a function of frequency, and associated with this is the resonance rectification probe based on the resonant increase in dc current due to rf excitation. The fourth probe is the high frequency capacitance probe, which is a special case of the impedance probe. Finally, dc current measurements with three different collectors are also carried out. Data from one daytime and one nighttime launching at Wallops Island are desired under stable ionospheric conditions to permit quantitative comparison of the different techniques. The principal theoretical and instrumental features of the different probes are presented in rather brief form; more complete descriptions will be published elsewhere. The auxiliary instrumentation is discussed in more detail in this report. Author

**N66-13567*#** Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.

**AN APPLICATION OF SAMPLING THEORY TO THE REDUCTION OF IONOGRAMS Scientific Report No. 242**

Raivo Vest 1 Jun. 1965 62 p refs

(Grant NsG-134-61)

(NASA-CR-68643) CFSTI: HC $3.00/MF $0.75 CSCL 04A

When ionograms are sampled to provide input data for a true height-electron density reduction program, errors, which are dependent on the sampling accuracy and on the quality of the ionograms, are introduced. The errors, introduced in the sampled values, are transformed by the reduction program to give errors in the estimation of the layer shape. The relationship between the errors in the virtual height profile and in the resulting true height profile has been examined by consideration of a parabolic layer model. This allows the layer shape to be characterized by three basic parameters: a layer thickness, a maximum layer density and a height at which this maximum occurs. Relationships between the distribution of the sampling points with respect to one another and to the layer maximum critical frequency are examined. Author

**N66-13571*#** Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

**TURBULENCE NEAR THE 100 KILOMETER LEVEL OF THE UPPER ATMOSPHERE**

C. G. Justus (M.S. Thesis) Nov. 1965 113 p refs

(Grant NsG-304-63; Contract AF 19(628)-393)

(NASA-CR-68708) CFSTI: HC $4.00/MF $0.75 CSCL 04A

The upper atmospheric turbulence has a rather sharp cutoff point, the turbopause, near 106 km as determined by examination of the maximum altitude of globule formation on many chemical releases. Suggested modifications are made for the form of the shear and energy spectrums of the turbulence. The turbulent mixing length was found to be about 0.75 km below the turbopause and to be rapidly increasing above this altitude. Thus the mixing length and maximum buoyancy scale are about equal in the region immediately below the turbopause. The characteristic time scale of the largest turbulent eddies

was found to be 300 to 330 sec. The usual Richardson, Townsend, and Layzer criteria for the onset of turbulence were examined and found to be unsuccessful in explaining the observed turbulence cutoff near 106 km. However, a generalized Richardson criterion was derived which does successfully predict turbulence only below 106 km. The Reynolds criterion was also examined and found to allow turbulence up to at most only a few km above the observed 106 km turbopause. E.E.B.

**N66-13582#** Georgia Inst. of Tech., Atlanta, Ga. Engineering Experiment Station.

**STUDY OF PHOTOCHEMISTRY, PHYSICAL STATE AND MOTION OF THE UPPER ATMOSPHERE Final Report, 1 Apr. 1962–31 Mar. 1965**

Howard D. Edwards Aug. 1965 14 p refs

(Contract AF 19(628)-393)

(AFCRL-65-690; AD-623469) CFSTI: HC $1.00/MF $0.50

The primary objectives of the contract were to gather photographic data from chemical releases which took place from rockets, and to analyze these data in terms of physical state and motion of the upper atmosphere. The data derived from the photographs have been used to determine horizontal and vertical winds, turbulence, diffusion and wind shears in the upper atmosphere. In addition to data reduction, a major portion of the contract efforts were devoted to development of equipment and the utilization of this equipment on field trips to Eglin Air Force Base, Florida and Cape Kennedy. Seven articles have been published covering the technical aspects of the work and one has been submitted for publication. Hence, this final report is essentially a compilation of abstracts from the published articles. Author (TAB)

**N66-13592#** Smithsonian Astrophysical Observatory, Cambridge, Mass.

**ANALYSIS OF ARTIFICIAL METEORITIC SPHERULES**

Frances W. Wright and Paul W. Hodge 8 Nov. 1965 11 p refs

(SAO Special Rept.-192)

Artificial meteoritic spherules, ranging in size from 10 to 150 $\mu$, have been produced in the laboratory by melting samples of an iron and a stony-iron meteorite with an electric arc welder and an acetylene torch. Microprobe chemical analyses showed the spherules to have a highly variable Fe/Ni ratio when analyzed by this method, tending to support the theory that magnetite spherules found in the upper atmosphere and in glacier deposits are extraterrestrial in origin. Author

**N66-13620#** Navy Underwater Sound Lab., New London, Conn.

**A GENERAL INTRODUCTION TO THE INTERNAL WAVES OF THE OCEAN**

Harold J. Doebler 13 Sep. 1965 19 p refs

(USL-696; AD-621336) CFSTI: HC $1.00/MF $0.50

Internal waves are cyclic depth oscillations of a density boundary within the volume of the medium. The effects of these waves in the ocean have been observed in both the propagation of underwater sound and hydrographic station data. This report reviews some of the technical literature with the intent of presenting and describing, in a simplified way, the characteristics of the internal waves of the ocean. Wave propagation velocities, lengths, and periods will be discussed, as well as some of the other factors of their occurrence. Author (TAB)

**N66-13655#** California Univ., Livermore. Lawrence Radiation Lab.

**STUDIES OF THE DIFFUSION PHENOMENA IN THE ATMOSPHERIC SURFACE LAYER. PART 2: DIFFUSION OF SMOKE PUFFS OF THE FLOATING INSTANTANEOUS-SOURCE TYPE**

Eiichi Inoue Jun. 1965 23 p refs Transl. into ENGLISH from Nogyo Kisho (Japan), v. 16, 1961 p 20–26

(UCRL-TRANS-1229(L)) JCL: HC $2.60/MF $0.89

An attempt was made to establish a connection between floating-source and fixed-source diffusion on the basis of the point of view that the differences that exist could be explained by taking into account the oscillation of the center of gravity of the smoke puff itself in the case of diffusion of the floating-source type. A firm method based on the Similarity Theory is proposed. The results showed that the characteristic figure that differentiates the two types of diffusion is the lifetime of the largest coupling eddy existing within the turbulent area brought about on diffusion. It was also found that the lifetime was characterized by the meandering of the line of smoke and by the change in movement of the degree of density of the smoke at a given point. It is tentatively suggested that the theoretical results and experimental results show a satisfactory degree of agreement. NSA

**N66-13701#** Deutscher Wetterdienst, Offenbach am Main (West Germany).

**CELL STRUCTURE OF THE ATMOSPHERE. ROCKET MEASUREMENTS EVALUATIONS AND COMPARISONS BETWEEN THE RESULTS OF SEVERAL YEARS Final Report, Jul. 1964–Jun. 1965**

Heinrich Faust and Eva Soos Aug. 1965 185 p refs

(Contract DA-91-591-EUC-3384)

(AD-471201)

Measurement results of the U.S. Meteorological Rocket Network for several years were summarized to May 1964 inclusive. Comparison of conditions in the different years was of main interest. The results refer to correlations between the zonal wind speeds in the high-tropospheric and mesospheric wind maximum layer; frequency distributions of the wind maxima in the vertical; relations between height and speed of the mesospheric wind maximum; times of circulation changes 1962 and 1963 in 30° and 40° N; monthly means of temperature in 30° and 60° N, averaged from 1960 to 1963, and in the single years; summer and winter temperature means in the single years; north–south differences of temperature; temperature differences between summer and winter. Subject to verification because of the spatially limited material, there are weak indications of a temperature decrease in greater heights toward the sunspot minimum. In several respects there are obvious similarities between the years 1961 and 1964, on the one hand, and between 1962 and 1963, on the other. A vertical oscillation of the north–south temperature gradient (60°–30° N), which was formerly found theoretically, seems to be confirmed. Author (TAB)

**N66-13728#** Defence Research Telecommunications Establishment, Ottawa (Ontario).

**ALOUETTE I IONOSPHERIC DATA N (h), VOLUME 3, NUMBER 1**

1 Oct. 1965 363 p CFSTI: HC $7.00/MF $2.00

Real height profiles obtained during 1963 from the Alouette I topside sounder satellite consist of electron number density profiles for selected groups of ionograms. Although spread F and other phenomena limit the accuracy of the profiles, a Q index has been established to indicate the quality of each ionogram record. A lamination method of analysis assumes a linear change of plasma frequency with height within each lamination. About 20 laminations are used for each ionogram; and the matrix elements are calculated using the dip angle and gyrofrequency appropriate to the location of the satellite at the time the sounding was made. Gyrofrequency is used both in the calculation of matrix elements, and in conversion from extraordinary wave frequency to electron number density. M.W.R.

**N66-13741#** Air Force Cambridge Research Labs., Bedford, Mass.

**GEOPHYSICAL IMPLICATIONS OF SHEAR DEFORMATION IN ROCKS**

Robert E. Riecker Jun. 1965 31 p refs *Its* Special Reports No. 27

(ARPA Order 292)

(AFCRL-65-457; AD-622573) CFSTI: HC $2.00/MF $0.50

The objective of the study is to determine shear strength, viscosity, and internal friction data for deep crust and upper mantle rock and mineral analogues under geophysically realistic conditions of very high temperatures and pressures. The data obtained through this study will be, initially, used to interpret earthquake origin and seismic signal generation; ultimately, it will be used to determine criteria that can be utilized to distinguish between natural earth phenomena and underground explosions. TAB

**N66-13745#** Air Force Cambridge Research Labs., Bedford, Mass.

**OZONESONDE OBSERVATIONS OVER NORTH AMERICA, VOLUME III**

Wayne S. Hering and Thomas R. Borden, Jr. Aug. 1965 226 p refs *Its* Environ. Res. Papers No. 133

(AFCRL-64-30(III); AD-623018) CFSTI: HC $6.00/MF $1.50

An experimental program for the measurement of the vertical ozone distribution was initiated by the Air Force Cambridge Research Laboratories in January 1963. A network of eleven ozonesonde stations was established in North America to provide high resolution observations of the vertical ozone distribution for a variety of research purposes. The resultant data are being published in a series of reports. The first volume (AD-435 873) contained the ozonesonde and associated radiosonde observations for the months of December 1962 through March 1963. The second volume (AD-604 880) contained the ozonesonde and associated radiosonde observations for the months of April through August 1963. Also included in Volume 2 were the average distributions of ozone over the North American continent as derived from the network observations. Data averages for overlapping bimonthly periods were presented for January–February through July–August 1963. This third volume presents the ozonesonde and radiosonde data for the months of September 1963 through August 1964.

Author (TAB)

**N66-13748#** American Meteorological Society, Boston, Mass.

**RADAR STUDIES OF ECHOES FROM A CLEAR SKY [RADIOLOKATSIONNYE ISSLEDOVANIIA OTRAZHENII OT IASNOGO NEBA]**

A. A. Chernikov Bedford, Mass., AFCRL, Jul. 1965 65 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 48, 1963 p 56–47

(Contract AF 19(628)-3880)

(T-R-480; AD-621419) CFSTI: HC $3.00/MF $0.75

General ideas about the seasonal and daily variations of the concentration, intensity, and other characteristics of echoes are formulated on the basis of various radar methods of investigating reflecting objects and information is acquired on the movement, structure, and form of the echo sources. These are used to construct a physical model of the observed phenomena. Author (TAB)

**N66-13755#** Library of Congress, Washington, D. C. Aerospace Information Div.

**METEORITES Translations of Soviet-Bloc Scientific and Technical Literature**

D. P. Grigor'yev et al 12 May 1964 35 p refs Transl. into ENGLISH from Meteoritika (Moscow)

(AID-U-64-35; AD-622241) CFSTI: HC $3.00/MF $0.75

Contents: Development of a mineralogy of meteorites; Composition of 18 stony meteorites from the collection of the USSR Academy of Science; Chemical composition of the chondrules of the Nikol'skoye and Saratov Meteorites; Relationship of various forms of iron in chondrites; Methods of studying meteorites and tektites with the help of infrared spectrometry. TAB

**N66-13759#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

**NOTE ON DETERMINING THE OVERALL DISTANCE SCALE OF THE EARTH USING HIGH ALTITUDE SATELLITES**

W. H. Guier 23 Jul. 1964 25 p ref

(Contract NOw-62-0604-c)

(CF-3098; AD-622479) CFSTI: HC $1.00/MF $0.50

The note presents the results of a recently complete simulation which indicates that satellite orbits with markedly different altitudes are required to determine accurately both the zeroth order zonal harmonic (the term in the geopotential representing the total force constant of the earth) and the distance scale to be applied to tracking station radii. While the simulation presents only the results for doppler data, the analysis shows that analogous results are to be expected for range data when comparable in accuracy to the doppler data. The results indicate that data which contains biases equivalent to about 5 meters position error cannot determine independently the total mass constant and distance scale factor to better than about 2/100,000 if only satellites of about 1000 km altitude are used. However, it is shown that if one satellite of at least 3000 km altitude is included, the error should be decreased to about 5/1,000,000. Radar range data with a bias error of less than 3 meters should allow the error to be reduced to below 1/100,000 for satellites of 1000 km altitude. Author (TAB)

**N66-13773#** Stanford Research Inst., Menlo Park, Calif.

**MEASUREMENT OF NITRIC OXIDE IN THE EARTH'S ATMOSPHERE Interim Report**

Robert A. Young 31 Jan. 1965 34 p

(Contract DA-49-146-XZ-112)

(DASA-1419-1; AD-622371) CFSTI: HC $2.00/MF $0.50

The report describes progress in development of rocket-borne nitric oxide detectors. TAB

**N66-13781** Air Force Systems Command, Wright-Patterson AFB, Ohio.

**COMPUTING THE RECEDING RADIATION OF THE EARTH BY MEANS OF ARTIFICIAL EARTH SATELLITE MEASUREMENTS**

L. R. Rakipov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 85–108 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Presented are formulas for the calculation of flows of receding radiation F from the "earth-atmosphere" system for instruments with limited and unlimited fields of view. An estimate is presented of the accuracy with which the flows of longwave radiation must be measured by artificial earth satellites. Examined are the effects of horizontal inhomogeneities of the flows F and the anisotropy of the radiation field. Author

**N66-13783** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**THE HEIGHT AND DIMENSIONS OF THE IONOSPHERIC NONUNIFORMITIES RESPONSIBLE FOR FLUCTUATIONS IN SIGNALS RECEIVED FROM ARTIFICIAL EARTH SATELLITES. I: NIGHT HOURS**

L. M. Yerukhimov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 137–156 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Presented are results from the measurements of heights and dimensions of the nonuniformities of the F-layer of the night ionosphere, obtained during the winter-spring of 1962 on the basis of observations of fluctuations in signals from artificial earth satellites on a frequency of 20 Mc. Analyzed is the change in the dimensions of the nonuniformities responsible for the fluctuations as a function of the height at which these nonuniformities are located. Demonstrated is an increase in the role played by small scale nonuniformities in the observed fluctuations (with dimensions of 200–300 m) under conditions of a perturbed ionosphere. Author

**N66-13784** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**MEASUREMENT OF THE ELECTRON CONCENTRATION OF THE UPPER IONOSPHERE WITH THE "KOSMOS"-SERIES ARTIFICIAL SATELLITES**

V. A. Misyura, G. K. Soludovnikov, and V. M. Migunov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 157–171 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

The paper presents one variety of the formulas used to determine the electron concentration of the ionosphere, whose coefficient of refraction depends on the three coordinates and on time, from the results of measurement of the reduced phase difference of coherent radio waves emitted by transmitters aboard satellites and rockets. The corresponding results of measurements obtained using the emission of a "Mayak" [Beacon] radiotransmitter aboard the Kosmos 11 earth satellite are considered. The electron-concentration curve along the orbit was found to be nonmonotonic above the principal ionization maximum. The hypothesis of "compression" of the upper ionosphere during the transition from the solar activity maximum to the minimum is confirmed. A maximum assigned to 150–180 km was detected in the dimension spectrum of the upper-ionosphere inhomogeneities. The nonregular deviations of the electron concentration range up to tens of percent of the regular value of N in major inhomogeneities. Author

**N66-13785** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CERTAIN POSSIBILITIES AND RESULTS OF IONOSPHERIC MEASUREMENTS FROM SLANT OBSERVATION OF THE FARADAY EFFECT IN GEOPHYSICAL-ROCKET SIGNALS**

V. A. Misyura, D. D. Osipov, Ye. B. Krokmal'nikov, and G. K. Solodovnikov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 172–189 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

A method is proposed for determination of the vertical distribution of electron concentration and electron content in a vertical column of the ionosphere and their horizontal gradients by two-station reception of radiowaves emitted by transmitters aboard satellites and rockets. The method is illustrated in application to observation of the so-called rotational Doppler effect (Faraday effect) of coherent radiation at frequencies of 48 and 144 Mc from a transmitter carried by a geophysical rocket launched to an altitude of about 500 km in the afternoon of 18 October 1962 in the middle latitudes of the Soviet Union. The measurement results are in agreement with data from measurements by another method and with data from vertical sounding of the ionosphere at several points. The resulting smoothed vertical "profiles" of the ionosphere are approximated well in the $F_2$ region by the parabolic-exponential model. The hypothesis of "compression" of the ionosphere during periods of diminishing solar activity is confirmed. Author

**N66-13889#** Naval Civil Engineering Lab., Port Hueneme, Calif.

**NAVY LABORATORIES RESEARCH, ANNUAL REPORT FY 65**

Aug. 1965 73 p refs

(Y-RO11-01; AD-619675) CFSTI: HC $3.00/MF $0.50

Contents: Accelerated Testing of Coatings; Investigation of Boiling Side Heat Transfer in Vapor; Near Infrared Attenuating Fluids; Physical Chemistry; Heat Storage with Salts; The Effects of Marine Organisms on Engineering; Materials for Deep Ocean Use; Solid State Electronic Devices; Emergency Sea Water Demineralizer; Investigation of Yaite; Eccentrically-Loaded Long Piles; Electromagnetic Cross Section of Material; Applied Mathematics; Unified Consolidation Theory; Static and Dynamic Failure Modes of Piles in Sand; Trafficability on the Ocean Floor; Biological Corrosion of Metals; Investigation of Film Evaporation on the Outside of Horizontal Tubes; A Graphical PERT Analog; Eye Protective Devices; Feasibility of Hydrodynamic Winch; Structural Plastics; Concrete Strain Studies with Photoelastic Coatings; Prepacked Concrete; Micro-Properties of Asphalt; Optimization of Heat Transfer in Multi-Stage Flash Evaporators; Shifting Ballast in a Rolling Unit as a Means of Locomotion for Deep Ocean Vehicles; Adsorption of Polymers onto Steel Surfaces; Effects of Pressure on Electrode Potentials; Laboratory Investigation of Underwater Curing Epoxies; Moisture Transmission Through Protective Coatings; Bioscience Studies; Investigation of Laser Effects and Devices; Seawater Battery; Study of Hardened VLF Antenna Concepts; and Research Applications of Radioisotope Techniques at NCEL. TAB

**N66-13892#** Ohio State Univ., Columbus.

**AN EXAMINATION OF THE ERRORS IN SHORT LINE MEASUREMENT WITH THE MRA2 TELLUROMETER**

Robert Edward Furry (M.S. Thesis) 1965 24 p refs

(Contract AF 33(608)-1095)

(AD-620417) CFSTI: HC $2.00/MF $0.50

The model MRA2 Tellurometer, an electronic distance measuring instrument used in geodetic surveying, is described. Its magnitude and type of errors in measurements over short lines are examined and its performance is compared with other models. R.N.A.

**N66-13995#** Joint Publications Research Service, Washington, D. C.

**THE STUDY OF METEOR MATTER**

T. N. Nazarova 4 Nov. 1965 6 p Transl. into ENGLISH from Geofiz. Byul. Mezhduved. Geofiz. Kom. pri Prezidiume, Akad. Nauk SSSR (Moscow), no. 14, 1964 p 89–91

(JPRS-32734; TT-65-33212) CFSTI: $1.00

A review and discussion of experimental measurements of meteoric dust particles in the interplanetary space near earth, recorded by piezoelectric sensors carried aboard earth satellites, is presented. The sensitivity to the impacts of meteor particles was recorded in different experiments on areas which differed somewhat in different cases from 0.1 to 4 $m^2$. The apparatus was calibrated for recording meteor particles with masses falling in three size ranges. Results of the observations revealed that at heights of 100 to 300 km above the earth's surface, the mean number of particle impacts with a mass of $10^{-8}$ was approximately 0.3/ $m^2$/sec. At heights of 400 to 2,000 km the number of impacts was smaller by a factor of approximately 100. At a distance from the earth of 10000 to 100000 km there were still fewer meteor particle impacts. Other observations are also made, among which it is concluded that the density of meteor matter in the earth's neighborhood is not stable. L.S.

**N66-13998#** Joint Publications Research Service, Washington, D. C.
**PRELIMINARY INTERPRETATION OF SOILS ON AERIAL PHOTOGRAPHS IN THE COMPILATION OF LARGE-SCALE SOIL MAPS**
V. A. Kalnina 7 Dec. 1965 18 p refs Transl. into ENGLISH from Pochvovedenie (Moscow), no. 8, 1865 p 81–88
(JPRS-33186; TT-65-33762) CFSTI: $1.00

A preliminary interpretation of aerial photographs of various landscapes is presented. The photographs are shown. The interpretation method uses the soil contours, and the appearance of the soil from the air as a basis for setting up a classification key. A combination of the preliminary interpretation made by the key classification, taken together with key diagrams made by field inspection promises a less time consuming method of interpreting aerial photographs of soils. L.S.

**N66-14009#** RAND Corp., Santa Monica, Calif.
**ON THE APPARENT BRIGHTNESS OF THE EARTH'S HALO**
R. C. Moore and G. F. F. Schilling Sep. 1965 26 p refs Submitted for Publication
(P-3232; AD-622416) CFSTI: HC $2.00/MF $0.50

Quantitative estimates of the brightness of the terrestrial halo at specific distances from within the shadow cone of the earth were obtained by a method that combines refraction and multiple scattering theory with observed twilight phenomena. Results are presented for a range of radial altitudes from 10,000 km to 250,000 km. Both the luminance, or surface brightness, of the atmospheric halo and the total brightness, or illumination, received by an observer within this altitude range are given. Author (TAB)

**N66-14031#** Montana State Univ., Missoula.
**FORCED VIBRATION OF UNEVENLY DISTRIBUTED MASSES**
Richard Randolph Frank (M.S. Thesis) Aug. 1965 44 p refs
(AD-620404) CFSTI: HC $2.00/MF $0.50

Forced vibration has been used extensively in the transportation or separation of various sized particles. The forcing frequency is usually created with a rotating or reciprocating unbalance that impresses a periodic, harmonic motion. This motion is directed to impart both a horizontal and a vertical movement to the particle. The development of the equations is shown, with their boundary conditions, that describe the motion of unattached particles on a vibrating platform. Results from these theoretical equations were tabulated in table form and compared with the test results. A high powered stroboscope was used with a photoelectric pickoff and a flash delay to photograph various stages in the cycle of rock particles on a vibrating platform. The position of the eccentric weights was used as a marker to determine the point in the vibrating platform's cycle that the photographs were taken. Various exciting frequencies and exciting forces were photographed for comparison with the theoretical results. TAB

**N66-14050#** National Physical Lab., New Delhi (India). Radio Propagation Unit.
**IONOSPHERIC DATA**
Mar. 1964 55 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res.
(RRC-A106) CFSTI: HC $3.00/MF $0.50

A tabulation of ionospheric propagation data collected in India is presented. Given are such data as ordinary wave critical frequency for the E, F-1, and F-2 layers; measurements influenced by spread echos; and the ordinary wave top frequency corresponding to the highest frequency at which a mainly continuous trace is observed in the E region. The geographic, geomagnetic, and magnetic locations of the stations, and some relevant details about equipments used are included. C.T.C.

**N66-14083#** Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
**ICE [FORMATION] AT ABOVE-ZERO AIR TEMPERATURE**
V. N. Kupecki Sep. 1965 3 p Transl. into ENGLISH from Priroda (Moscow), v. 6, 1965 p 81–82
(T-441-R) CFSTI: HC $1.00/MF $0.50

The formation of a sea ice rind, occurring under the 24-hour Polar illumination summer and at above-zero air temperatures, is described. Ice reconnaissance found extensive ice rind patches forming in Yenissi Bay, fringing the eastern fast-ice edge in a band 100 to 200 m wide. Air temperatures in the layer adjacent to the water were reported at 1° to 3° C in nighttime, and at 4° to 5° C in the daytime hours. Based on this phenomenon, it was pointed out that statements on the impossibility of the Arctic ice cover reforming spontaneously if it were artifically destroyed are open to question. M.G.J.

**N66-14117*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**INTERPRETATION OF VACUUM-GAUGE DATA FROM EXPLORER XVII**
Donald R. Hardesty, S. B. Pearce, and G. P. Newton *In its* Goddard Summer Workshop Program [1964] 25 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The Explorer XVII carried four ionization vacuum gauges: two modified Bayard-Alpert hot filament gauges and two modified Redhead cold-cathode magnetron gauges. One gauge of each type was placed on the satellite's spin equator and the remaining two gauges were symmetrically located off the equator. The data from the two equatorial gauges were analyzed in order to compare the two types of gauges under similar conditions. Pressure-time characteristics for the two gauges are given. The temperature effect on the Redhead gauge response was found to be small. Also, theoretical calculations supported the observed phenomena of no phase shift in the Redhead gauge response to the spin-modulation of the pressure. Correlations were made of time constants obtained from straight-line fits to the indicated Bayard-Alpert residual pressure decays. From these correlations, strong indications were obtained of more rapid gauge clean-up early in the life of the gauge and of cleaner gauge operation when the satellite has remained above 350 km with an off-time less than the theoretical time for monolayer adsorption. E.E.B.

**N66-14147#** Defence Research Telecommunications Establishment, Ottawa (Ontario).
**ALOUETTE I: ALOSYN IONOSPHERIC DATA, 16 JANUARY 1963 TO 31 JANUARY 1963**
[1965] 154 p CFSTI: HC $5.00/MF $1.00

Topside sounder synoptic data from Alouette I are tabulated for the period. The data consists of selected ionospheric parameters obtained from the ionograms. E.E.B.

**N66-14148#** Defence Research Telecommunications Establishment, Ottawa (Ontario).
**ALOUETTE I: ALOSYN IONOSPHERIC DATA, 1 JANUARY 1963 TO 15 JANUARY 1963**
[1963] 116 p CFSTI: HC $4.00/MF $0.75

Selected ionospheric parameters obtained from Alouette I ionograms are tabulated in the order in which the ionograms were recorded. The Alouette I satellite is an almost circular orbit with an inclination of 80.5°. The orbital period is 105.4 minutes. The radio frequency of the topside sounder changes continuously from 0.5 to 11.5 Mc/sec. The complete sweep takes approximately 11 seconds. E.E.B.

**N66-14149#** Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

**AIRBORNE MEASUREMENT OF MICROWAVE EMISSION FROM THE EARTH'S SURFACE AND ATMOSPHERE**

H. A. Hyatt [1965] 23 p refs Presented at the Electromagnetic Sensing Symp., Univ. of Miami, Coral Gables, Fla., 22–24 Nov. 1965 *Its* Paper No. 3684)

(Contract CWB-10932)

This paper reveals the results of a theoretical and experimental investigation of the microwave radiation emitted by the Earth's surface and atmosphere. The study objective was to evaluate the potential application of microwave radiometry to weather satellite reconnaissance. Measurements were obtained by flying an aircraft-mounted radiometer (sensing fluxes at frequencies 22.235 GHz and 15.78 GHz) at high and low altitudes over the Pacific Ocean and Southern California terrain. Average emissivities of 0.85 for the land and 0.53 for the ocean were computed from these measurements. The measurements indicated an average emission line amplitude of 20 ±2° K over oceanic areas at both high (35,800) and low (1,600 ft) altitudes, while the average emission measured over the land was 12 ±2° K. Small nonprecipitating clouds had very little effect on the outgoing radiation field. The data trends in this experiment agree with theory, but the effects of changes in surface emissivity and reflectivity, and in the atmosphere's vertical structure, cannot be explicitly separated for interpretation. Author

**N66-14175#** Canadian Armament Research and Development Establishment, Valcartier (Quebec).

**RESULTS OF THE NITRIC OXIDE SEEDING PROGRAM**

G. B. Spindler Sep. 1965 85 p refs

(CARDE-TR-538/65) CFSTI: HC $3.00/MF $0.75

Observations on a series of nitric oxide releases in the E-Region are described. As a result of these observations, changes are suggested in the current kinetic theory of the NO – O reaction and a new reaction model is presented. It is proposed that the NO – O reaction, at least at E-Region pressures, is bimolecular and, in line with the findings of other experimenters, that the effective rate constant there may be faster than the value obtained for this reaction in the laboratory. Atomic oxygen profiles for two different latitudes are presented as well as evidence for a latitude effect on the profiles. The altitude at which atmospheric flow changes from turbulent to laminar is also different at these two latitudes. It is probable that atomic oxygen concentration drops sharply below 80 km, but above the peak of the profile, concentration falls with a first decadic scale height of 14 km, in agreement with photochemical theory. Observations on the wind-distorted luminous trail show a strong wind shear present in each case near 100 km. Author

**N66-14203#** Naval Ordnance Test Station, China Lake, Calif.

**PROJECT TBIRD Final Data Report, May 1961–Oct. 1963**

Frank B. St. George Nov. 1965 65 p refs

(NOTS-TP-3651; NAVWEPS-8622; AD-623582) CFSTI: HC $3.00/MF $0.75

Rocket probe experiments designed to measure and map apparent spectral radiance of terrestrial high altitude clouds from space (83 kilometers peak altitude) are reported. Measurement technique, experimental design and quantitative infrared data in five narrow regions of the spectrum from 1.9 to 6.7 microns are presented. Terrestrial spectral radiance maps obtained at 2.2, 2.7, 4.3, and 6.7 microns and typical radiance contour maps are also presented. Author (TAB)

**N66-14208#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div

**REPORT OF INVESTIGATIONS IN THE FIELD OF GRAVIMETRY, CONDUCTED IN THE USSR IN 1962–1965**

Yu. D. Bulankhe and L. P. Pellinen 20 Oct. 1965 30 p refs Transl. into ENGLISH of the publ. "Soobshcheniye ob Issledovaniyakh v Oblasti Gravimetrii, Vypolnennykh v SSSR v 1962–1965 GG" Moscow, Akad. Nauk SSSR, Sov. Geofizicheskiy Kom. Sekts. Geodezii, 1965 26 p

(FTD-TT-65-1559/1+4; AD-623273) CFSTI: HC $2.00/MF $0.50

Several Soviet investigations in the field of gravimetry are discussed and include the development of national reference networks and testing areas for calibrating gravimeters; gravity measurements on the sea and in the air; determination of the earth's shape, dimensions, and gravity field; secular changes of gravity; the gravitational constant; and the gravitational field of Antarctica. R.N.A.

**N66-14217#** Defence Research Telecommunications Establishment, Ottawa (Ontario).

**ALOUETTE I: ALOSYN IONOSPHERIC DATA, 1 AUGUST TO 15 AUGUST 1963**

[1963] 166 p CFSTI: HC $5.00/MF $1.00

Alouette topside sounder synoptic data, designated Alosyn, consisting of selected ionospheric parameters obtained from Alouette I ionograms are presented. The parameters are listed in the order in which the ionograms are recorded, one tabulation row for each ionogram. The parameters are tabulated for all sounder data recorded at telemetry stations from August 1 to August 15, 1963. R.N.A.

**N66-14231#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**INVESTIGATION OF DRIFT IN THE E REGION OF THE IONOSPHERE**

O. Ovezgel'dyyev and L. P. Korsunova 17 Sep. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekhn., Khim. i Geol. Nauk (Ashkhabad), no. 2, 1964 p 21–26

(FTD-TT-65-767/1+2; AD-622422) CFSTI: HC $1.00/MF $0.50

The dynamo theory of geomagnetic variation is discussed. TAB

**N66-14259#** Kiruna Geophysical Observatory (Sweden).

**KIRUNA GEOPHYSICAL DATA, JANUARY–MARCH 1965**

W. Riedler, ed. [1965] 48 p

(Rept.-65/1) CFSTI: HC $2.00/MF $0.50

A tabulated summary is given of geophysical data related to polar upper atmosphere conditions. These are geomagnetic K-indices; ionospheric absorption (during first minute of each hour, peak during each hour); visible auroral index; and earth current. Diagrams are included for mean diurnal variation of cosmic noise absorption; day-to-day variation of cosmic noise absorption; mean diurnal variation of oblique VHF auroral echo occurrence; day-to-day variation of oblique VHF auroral echo occurrence; average diurnal variation of the 16 kc/s transmissions; and day-to-day variation of the 16 kc/s transmissions. C.T.C.

**N66-14260#** Kiruna Geophysical Observatory (Sweden).

**KIRUNA GEOPHYSICAL DATA, APRIL–JUNE 1965**

W. Riedler, ed. [1965] 33 p For abstract see N66-14259 04-13

(Rept.-65/2) CFSTI: HC $2.00/MF $0.50

N66-14267# Royal Aircraft Establishment, Farnborough (England).
**THE MEASUREMENT OF THE EARTH'S INFRA-RED RADIATION FROM A SKYLARK ROCKET**
J. K. Moore Aug. 1965 40 p refs
(RAE-TR-65166) CFSTI: HC $2.00/MF $0.50

Skylark rockets SL.134 and SL.135 carried experiments to measure the infrared radiation from the earth in day and night conditions. The experimental infrared instrumentation is described, and a selection of results is shown. Sufficient measurements have been made to assess the radiation gradient at the earth-space horizon, and an infrared map of the area scan has been produced. Due to the failure of Skylark SL.135, 10 sec after launch, data was collected only under nighttime conditions; also, the unfortunate motion of SL.134 in space caused a paucity of information in the standard Skylark attitude instrumentation, resulting in poor attitude definition. Thus independent checks of rocket attitude are not available, and although analysis of the records has permitted a determination of the infrared radiation profile of the earth to be made, accurate positioning of the profile with reference to the earth has proved impossible. Author

N66-14283*# Arizona State Univ., Tempe.
**CATALOG OF METEORITES IN THE COLLECTIONS OF ARIZONA STATE UNIVERSITY, INCLUDING THE NININGER METEORITE COLLECTION**
Carleton B. Moore and Charles F. Lewis 1964 209 p
(Grant NsG-399)
(NASA-CR-68989) CFSTI: HC $5.00/MF $1.25 CSCL 08G

In this catalogue, the meteorites are classified according to Mason's *Meteorites*, with the olivine-bronzite chondrites and the olivine-hypersthene chondrites subdivided according to falls or finds. The regulations for administering the collection are listed, along with pertinent data on requesting material and specimens for research purposes. M.G.J.

N66-14307# Texas Instruments, Inc., Dallas. Science Services Div.
**30-DAY OCEAN-BOTTOM SEISMOGRAPH, ALEUTIAN-KURILE OPERATIONS Final Report, 1 Oct. 1965–31 Aug. 1965**
William A. Schneider and Patrick J. Farrell 31 Oct. 1965 33 p refs
(Contract AF 19(628)-4075; ARPA Order 292)
(AFCRL-65-765; AD-623512) CFSTI: HE $2.00/MF $0.75

The 30-day ocean-bottom seismograph senses ground motion through 1 vertical and 2 horizontal velocity seismometers and pressure variations through a transducer capable of response to 1.0 cps. Data are recorded continuously on magnetic tape and the unit has a depth capability of 25,000 ft. During the summer and fall of 1964, several drops were made in the area south of the Aleutian chain and northeast of the Island of Hokkaido, Japan. Power density spectra of ambient noise samples over a long time interval were selected from the two areas. Plots of these data vs time are presented and compared with simultaneous meteorological maps covering the respective areas. These results show a direct relationship between ambient noise levels and local meteorological changes. In fact, low-pressure disturbances were observed to cause up to 20 db increase in ambient noise level in the 0–2.0 cps range. Ambient noise levels that previously were observed and reported appear consistent with current findings. Author (TAB)

# 14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-13376# National Academy of Sciences—National Research Council, Washington, D. C. Mine Advisory Committee.
**ULTRASONIC IMAGING**
R. Stuart Mackay, ed. Apr. 1965 79 p refs Proc. of a Symp. held at Berkeley, Calif., 1–2 Dec. 1964
(AD-621372)

CONTENTS:

1. ULTRASONIC IMAGING—A REVIEW OF PRINCIPLES, SENSORS, POTENTIALS, AND LIMITATIONS W. R. Turner p 1–37 (See N66-13377 04-14)
2. RECENT CONSIDERATIONS ON THE ULTRASOUND IMAGE CAMERA C. N. Smyth p 39–58 refs (See N66-13378 04-14)
3. APPLICATIONS AND LIMITATIONS OF THE ULTRASOUND IMAGE CONVERTER IN ACOUSTIC IMAGING J. E. Jacobs p 59–75 refs (See N66-13379 04-14)

N66-13377 Vitro Labs., Silver Spring, Md.
**ULTRASONIC IMAGE—A REVIEW OF PRINCIPLES, SENSORS, POTENTIALS, AND LIMITATIONS**
William R. Turner *In* NAS-NRC Ultrasonic Imaging Apr. 1965 p 1–37 (See N66-13376 04-14)

The fundamental principles of ultrasonic imaging are set forth, the electronic type image sensor is discussed, and the potentials and limitations of ultrasonic imaging are developed for several applications. Although light and sound differ in the nature of their propagation medium, the fundamental wave propagation characteristics are identical. Image formation is summarized by noting that images can be formed with either light or sound energy by casting a shadow or by using a lens or mirror to focus the wave energy scattered by the object into an image. The same laws of refraction and reflection apply to both sound and light. However, the relative sources of image imperfection differ greatly because of the wavelength difference between them. The image sensor is the key problem. Once satisfactory sensors are available, the task of developing many other critical system components and of applying these components to specific problems can be initiated. E.E.B.

N66-13378 London Univ., (England).
**RECENT CONSIDERATIONS ON THE ULTRASOUND IMAGE CAMERA**
C. N. Smith *In* NAS-NRC Ultrasonic Imaging Apr. 1965 p 39–58 refs (See N66-13376 04-14)

The development and problems of ultrasonic camera tubes, cameras, and acoustic-optics are discussed. The problems facing the ultrasonic camera designer are to increase the screen size; to introduce photo mosaics, flood guns, and circuitry for pulsed ultrasound and gated image storage in the camera; and to reduce artefacts in the signal. E.E.B.

N66-13379 Northwestern Univ., Evanston, Ill. Biomedical Engineering Center.
**APPLICATIONS AND LIMITATIONS OF THE ULTRASOUND IMAGE CONVERTER IN ACOUSTIC IMAGING**

John E. Jacobs *In* NAS-NRC Ultrasonic Imaging Apr. 1965 p 59–75 refs (See N66-13376 04-14)
(Grants PHS-GM-08522-03; PHS-FR-00018-03)

The limitations to sensitivity and detail resolution of the ultrasonic image converter are discussed and areas in which future technical development is needed are indicated. It is concluded that future work relating to the ultrasonic camera should be concentrated in introducing storage into the tube operation characteristics, extending the operating range of the system to the 100 Mc frequency range, increasing the area of the input surface of the image tubes, and expanding the application of the available camera systems to those areas where the unique propagation characteristics of ultrasound permit visualization of detail not discernable by means of other types of radiation. E.E.B.

**N66-13422** Joint Publications Research Service, Washington, D. C.
**ELECTRONICS IN AERIAL SURVEYING**
Wei-Hsing Kuo *In its* Transl. on Communist China's Sci. and Technol., No. 233 5 Nov. 1965 p 61–66 Transl. into ENGLISH from Wu-hsien-Tien (Peking), no. 8, 12 Aug. 1965 p 1–2 (See N66-13419 04-34) CFSTI: $3.00

The following radio electronic photographic methods are evaluated for their application in aerial surveying: *Television Photography*—modulated video signals from cameras are transmitted by radio waves to ground receivers; (2) *Infrared Photography*—infrared radiation from slight temperature differences are used to construct pictures of different shades; (3) *Radar Photography*—pulse transmission to receiver screen; (4) *Electronic Printing, Developing, and Enlargement*—light equilibrium through control of brightness, and automatic processing of pictures; (5) *Horizontal Photography*—electronic adjustment system for non-horizontal photography; and (6) *Preparation System of Stereoscopic Map*—construction of stereo image from two pictures with different perspective angles. G.G.

**N66-13425#** Union Carbide Nuclear Co., Oak Ridge, Tenn.
**PRINCIPLES AND OPERATION OF THE ALIGNMENT INTERFEROMETER**
R. R. Baldwin and L. G. Whitten 30 Nov. 1965 34 p refs
(Contract W-7405-ENG-26)
(Y-1489) CFSTI: $2.00

The alignment interferometer has been developed as an instrument for measuring deviations from straightness. Measured values are read directly as linear displacement without resorting to trigonometric conversion techniques. Orientation of the instrument is used to readily isolate slide errors due to pitch and yaw. This technique greatly simplifies error analysis and correction. A deviation from a straight line of less than 10 microinches can be detected at a distance of two yards. Calibration is performed with routine procedures and equipment. Author

**N66-13436#** White Sands Missile Range, N. Mex. Instrumentation Development Directorate.
**AUTOMATIC METEOROLOGICAL BALLOON TRACKER**
Harold A. Lambeth Jan. 1965 27 p
(STEWS-ID-65-1; AD-460567)

This report describes the design and development of an automatic meteorological balloon tracker capable of sensing and acquiring a meteorological weather balloon at its launch site and automatically tracking its flight to an altitude of 10,000 to 15,000 feet. System components are described including the electrostatic vidicon camera, lens system, and error signal generator. Field tests demonstrated the tracker's ability to provide the required data. R.N.A.

**N66-13533#** Institut Franco-Allemand de Recherches, St. Louis (France).
**IMPROVEMENT OF METHODS TO MEASURE VARIATIONS OF SHORT LASTING PRESSURE [VERBESSERUNG DER METHODEN ZUR MESSUNG KURZZEITIGER DRUCKVORGANGE]**
M. Froboese 12 Jul. 1963 25 p refs In GERMAN
(ISL-T-16/63) CFSTI: HC $1.00/MF $0.50

Described are piezoelectric gauges made from quartz or lead-zirconate transducers that can be used to register and quantitatively measure the time-pressure relationship for very weak detonation waves. Quartz rods were used to obtain: (1) pressure profiles of non-reflecting shock waves; (2) measurements on distant detonation sources generating shock waves at certain heights in the atmosphere; and (3) measurements on detonation sources that distribute fragmentation matter. Reflecting lead-zirconate transducer disks with silver electrodes were used to receive very weak pressure waves that were reflected from the earth's surface. Time deflection of the cathode registration for both gauges was 0.2 ms/sec. Transl. by G.G.

**N66-13611#** National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.
**ACCURACY IN MEASUREMENTS AND CALIBRATIONS, 1965**
W. A. Wildhack, R. C. Powell, and H. L. Mason, ed. 15 Jun. 1965 146 p refs
(NBS-TN-262) GPO: $1.00

Estimates of uncertainties associated with physical measurements and calibrations are shown by 66 provisional accuracy charts. Each chart is accompanied by a brief statement of the state of the art and tentative plans for work in areas where improvement is needed. C.T.C.

**N66-13625#** Astrosystems International, Inc., Fairfield, N. J.
**INVESTIGATION OF AN ELECTROMAGNETIC TECHNIQUE FOR THE INDEPENDENT MEASUREMENT OF CHEMICAL ROCKET EXHAUST VELOCITY AND VECTOR Final Report, Dec. 1963–Mar. 1965**
J. C. Holme Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1965 120 p refs
(Contract AF 33(615)-1197)
(TR-63083F; AFFDL-TR-65-98; AD-619691) CFSTI: HC $4.00/MF $1.00

An analytic and experimental study was made of an electromagnetic technique for the in-flight measurement of chemical rocket exhaust gas velocity vector. A ground test design, using an alternating magnetic field, was fabricated and tested on 40:1 and 10:1 area ratio nozzles with a gaseous oxygen–methane propellant combination. The ability of the E-M device to deliver a reproducible output voltage as a linear function of rocket exhaust gas velocity was demonstrated. However, at the present time, calibration for varying flow rates is required. Test results also suggest a possible extension of the electromagnetic technique to the measurement of mixture ratio, mass flow rate and other rocket engine parameters. Techniques for adapting the electromagnetic approach to ground and flight test applications are discussed. Author (TAB)

**N66-13629#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
**APPLICATION OF SEMICONDUCTOR GALLIUM ARSENIDE LIGHT SOURCES FOR CALIBRATING SYSTEMS USING SEMICONDUCTOR NUCLEAR RADIATION DETECTORS**
V. V. Naumov, M. N. Omel'yanenko, V. I. Rykalin, and V. F. Titova 1965 15 p refs In RUSSIAN
(JINR-P-2262) CFSTI: HC $1.00/MF $0.50

The calibration of a telescope having four layers of silicon nuclear radiation detectors is described. The telescope is calibrated by means of gallium arsenide light source. The characteristics of the gallium arsenide light source. The characteristics of the gallium arsenide light sources are given. The results of investigations of the silicon detector characteristics are presented. Author

N66-13656# Los Alamos Scientific Lab., N. Mex.
**THE SINGLE-SPHERE NEUTRON MONITORING INSTRUMENT**
Dale E. Hankins [1965] 5 p refs Presented at 1st Symp. on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.
(Contract W-7405-ENG-26)
(LA-DC-7323; CONF-651109-1) CFSTI: HC $1.00/MF $0.50

The Bonner sphere technique of measuring neutron spectra consists of a LiI crystal which is placed in the center of 2, 3, 5, 8, and 12 inch spheres. A summary of recent developments concerning a single sphere neutron monitoring instrument, which consists of placing the LiI crystal in the center of a 10 inch sphere, is given. NSA

N66-13666# Battelle-Northwest, Richland, Wash.
**A ROLL FILM CAMERA FOR REMOTE METALLOGRAPHY**
D. J. Meyers, A. J. Gruber, and R. J. Roach 1965 4 p refs Presented at the 13th Conf. on Remote Systems Technol., Washington, D. C.
(Contract AT(45-1)-1830)
(BNWL-SA-161; Conf-651101-14) CFSTI: HC $1.00/MF $0.50

A motor-driven roll film camera was adapted for use with remote metallographs. The camera system includes reflex photographic attachments, roll film magazines, a motorized film advance drive, an electronic interval timer, and an electric shutter. A description is given of the camera and its operation. NSA

N66-13685# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
**SOLID STATE RADAR ALTIMETER DEVELOPMENT**
W. F. Mc Carty 13 Sep. 1965 10 p
(NADC-AE-6510; AD-622981) CFSTI: HC $1.00/MF $0.50

A study of the feasibility of generating microwave signals from solid state sources, and the analysis and design of varactor multipliers were undertaken as the first phase in the possible development of a solid state radar altimeter. The results showed that a solid state microwave generator is possible, and a completely solid state radar altimeter is feasible. Author (TAB)

N66-13703# Weapons Research Establishment (Australia). Dept. of Supply.
**AN EXPERIMENT USING METEOROLOGICAL BALLOONS TO DETERMINE THE LIMITING PHOTOGRAPHIC RANGES OF DISTANT SPHERES**
D. J. Gambling Sep. 1965 34 p refs
(ISD-63) CFSTI: HC $2.00/MF $0.50

A series of meteorological balloons ranging in diameter from 6 in. to 5 ft were released from the Woomera Range and photographed by selected Kinetheodites. The angular diameters of the balloons which were liminally detectable on film were determined and are presented here as functions of the relevant parameters. It is shown that for a constant elevation angle the angular detectability of highlighted objects can actually increase with the range. Author

N66-13747# David Taylor Model Basin, Portsmouth, Va. Structural Mechanics Lab.
**A PROCEDURE FOR THE CORRECTION OF VELOCITY METER RECORDS**
Ramon R. Walker Jun. 1965 16 p refs
(DTMB-1980; AD-621674) CFSTI: HC $1.00/MF $0.50

Correction methods devised to compensate for certain mechanical characteristics of commonly used velocity meters are considered. The application of two corrections for such characteristics, usually referred to as seismic corrections and correction for bottoming, is illustrated and discussed for the measurement of absolute structural velocities. The correction procedures are shown to be theoretically justified. These procedures for correcting the velocity meter output in the measurement of absolute velocities are based on two major premises: One is that the suspension system is linear, and the other is that the entire system is at rest prior to the arrival of the shock motion. Although the procedures thus derived will be applicable in most practical situations, no fundamental limitation dictates either requirement. The procedure can be readily extended to cover the situations where only one or neither of these requirements is met, provided of course, that those situations can be adequately described. Author (TAB)

N66-13793 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATION OF A ROCKET-CARRIED ELECTROSTATIC FLUXMETER**
Ya. M. Shvarts, N. T. Markchev, A. N. Petunin, V. P. Rudakov, and V. V. Skvortsov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 270–275 refs (See N66-13776 04-30)
CFSTI: HC $6.00/MF $1.50

Laboratory studies indicate the feasibility of a rocket-borne electrostatic flux meter for making measurements of the surface electrostatic field on rockets in the upper atmosphere. Use of grid plates in the sensor's electrostatic generator and special methods for precision tuning of the synchronous detector are necessary. The effectiveness of noise current suppression in electrostatic flux meters can be evaluated from theoretical findings. M.W.R.

N66-13852# California Univ., Berkeley. Lawrence Radiation Lab.
**DESIGN, CONSTRUCTION AND OPERATION OF A DIFFERENTIAL MICROMANOMETER. PART II: THEORY AND OPERATIONAL CHARACTERISTICS**
Peter R. Rony 8 Apr. 1965 120 p refs
(Contract W-7405-ENG-48)
(UCRL-11218, Pt. II) CFSTI: HC $4.00/MF $0.75

A differential micromanometer capable of measuring 100 μtorr to an accuracy of ±2% was designed, constructed, and tested. The micromanometer is being used as a Wrede-Harteck gauge, a device that converts an atom concentration into a pressure differential in a low-pressure gaseous system. The pressure difference is sensed by a membrane manometer constructed as a differential capacitor that forms two legs of a resonant-bridge network excited by a radio-frequency source. The bridge output (2.762 Mc/sec) is amplified and fed to a phase-sensitive detector that determines the direction of unbalance and develops a d-c voltage that can be used (a) in a feedback-loop system to restore the diaphragm to its null position, or (b) in an open-loop system and recorded directly. The most favorable system found to date consists of a Decker Corporation Model 306-2A pressure transducer operated open loop with the bridge and electronics. Differential pressures as low as 50 μtorr can be measured with a zero drift of about 30 μtorr or less per hour (approximately 1 μtorr per min) in

a room regulated to within ±0.5° C. Differential pressures of 0.5 μtorr are detectable. An attenuator in the amplifier section extends the 306-2A system to differential pressures as large as 35 μtorr. The micromanometer is calibrated electrostatically. The diaphragm constant K in the formula $\Delta P = KV^2$ is determined to ±2% by comparison of the readings produced by a known pressure differential, measured with an accurate McLeod gage, and a voltage of known magnitude applied to one side of the differential capacitor. Once the gage constant is known, the system can be calibrated daily by application of a series of known voltages and a plot of the recorder reading vs the square of the voltages. In the pressure region of 0.1 to 35 μtorr, the system is an excellent secondary pressure standard. The characteristics of the differential micromanometer are compared to those of ten other differential micromanometer systems. Author (NSA)

**N66-13858#** Sandia Corp., Albuquerque, N. Mex.
**BASIC PRINCIPLES OF FUNCTIONAL GAGING**
Edward S. Roth Jul. 1965 9 p refs Presented at Am. Soc. of Tool and Mfg. Engr. Ann. Conf., Cleveland
(Contract AT(29-1)-789)
(SC-R-65-915; CONF-650327-1) CFSTI: HC $1.00/MF $0.50

Two kinds of functional gages are briefly discussed. The first is a feature relation gage and the second a feature location and relation gage. Ten basic design principles of these gages are reviewed. A brief discussion of basic interchangeability gage forms is presented. Author (NSA)

**N66-13891** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DEVICE FOR MEASUREMENT OF TEMPORARY INTERVALS**
N. A. Pelyka and A. V. Pronyushkin 18 Mar. 1964 7 p Transl. into ENGLISH from Soviet Patent no. 144880 (Appl. no. 697051/26, 9 Feb. 1961) p 1-2 Submitted for Publication
(FTDMT-63-276; AD-619549) CFSTI: HC $1.00/MF $0.50

The object of the invention is a device for measurement of time intervals, containing a pulse generator, electronic counter, block of synchronous disconnecting of the counter during interrogation, circuit of reading of intermediate readings of the counter and memory block, carried out on the electron-beam instrument, distinguished by the fact that, for the purpose of increase of accuracy of measurement, in it as an electron-beam instrument is applied a double-beam electron tube, while the second beam is used for forming of high-speed scanner and block of synchronous disconnecting of electronic counter during interrogation. Author (TAB)

**N66-13968*#** Rosemount Engineering Co., Minneapolis, Minn.
**STUDY TO DETERMINE SUITABLE HIGH TEMPERATURE, HIGH ALTITUDE, TOTAL TEMPERATURE SENSORS**
**Final Report**
Richard V. De Leo and A. E. Saari 5 Nov. 1965 88 p refs
(Contract NAS8-11191)
(NASA-CR-68875; REC-116528) CFSTI: HC $3.00/MF $0.75
CSCL 14B

Two pairs of total temperature sensors were fabricated. The two sensor configurations were designated as Models 107C-1 and 107C-2. It was recommended that Model 107C units should be tested for in-flight performance, perhaps on a flight vehicle such as the X-15. Also, no further supersonic wind tunnel tests were considered necessary. Temperature step transients and turbulence associated with wind tunnel testing do not occur in actual flight operation. Sensor temperature stabilization before the temperature step is questionable and may influence test results. Based on available data, a minimum of about 10 sec after the temperature step is necessary for obtaining an acceptable temperature prediction. Test results of prototype sensors calibrated in the internal flow apparatus indicate uniform calibration results for sensor operation at total pressures down to 1/4-inch mercury. Turbulence level influence of time constant and its effect on single sensor performance could be investigated; reliable operation of sensors in pairs is expected, regardless of turbulence levels. E.E.B.

**N66-14007#** Dayton Univ., Ohio.
**FLIGHT TEST EVALUATION OF THE A/A24U-6 STRUCTURAL LOADS DATA RECORDING SYSTEM**
Robert J. Dominic Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1965 60 p ref
(Contract AF 33(615)-1478)
(AFFDL-TR-65-178; AD-622282) CFSTI: HC $3.10/MF $0.75

A flight test evaluation of the Whittaker A/A24U-6 Structural Loads Data Recording System was conducted to determine the capability of the recorder to acquire flight loads data for use in the Air Fore Structural Integrity Program. The system consists of a small, eight-channel, airborne, digital tape recorder; a magnetic tape magazine; and a ground playback converter. A 24-flight evaluation program was conducted using an F-102 aircraft to acquire a nominal sample of VGH flight loads data. Measurements of identical acceleration peaks were successfully correlated on both systems by signals from a precise, master, time reference source recorded by both systems. The Whittaker system was found to be a reliable means of recording both 6 cps and 12 cps vertical acceleration data. Comparisons of acceleration frequency distributions indicated that those data obtained from the Whittaker recorder had essentially the same distribution function as data obtained simultaneously by the oscillograph recorder. Pressure transducers used to measure airspeed and altitude were judged to be less accurate and less reliable than the rest of the Whittaker system. It is concluded that overall system accuracy can be increased by increasing the digital count of the acceleration, airspeed, and altitude measurements to seven digital bits. Author (TAB)

**N66-14047#** Midwestern Universities Research Association, Madison, Wis.
**HIGH SPEED DIGITAL DYNAMIC FIELD MEASURING SYSTEM**
G. E. Bush 31 Aug. 1965 20 p refs Prepared for Argonne Natl. Lab. Sponsored by AEC
(MURA-716) CFSTI: $1.00

A facility for measuring high gradient time variant magnetic fields has been developed. The system consists of pickup coils, integrators, a multiplexer, one analog-to-digital converter, and an IBM 1401 computer. There are nine precision-wound dipole pickup coils that are placed in the unknown field. The induced coil voltages are fed into nine precision integrating amplifiers whose outputs are proportional to the ΔB that is seen by the nine coils. These outputs plus the signal from a current shunt placed in the magnet excitation line are then sequentially scanned by a ten-channel multiplexer. The multiplexer feeds a high speed analog-to-digital converter which feeds the computer through a parallel to serial converter. This measuring system was designed to be fast enough so that interpolation to any point in time is possible. The coils were designed to be insensitive to the second and third spatial field harmonics and thereby effectively measure fields at a point instead of over the whole coil area. The direct link to the computer is a two-way tie, with data flowing to the computer and control signals flowing to the measuring system. Author

**N66-14073#** Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
**MECHANICAL TIME-SHUTTER FOR SPECTROGRAPH WITH EXPOSURE-TIMES FROM 1.5 μS TO 3 MS [UN OBTURATEUR MECANIQUE POUR SPECTROGRAPHE DONT LE TEMPS D'EXPOSITION VARIE DE 1,5 MICROSECONDE A 3 MILLISECONDES]**
L. Becker and H. W. Drawin Brussels, EURATOM, Sep. 1965 25 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(EUR-2440.f; CEA-R-2816) CFSTI: HC $1.00/MF $0.50

A mechanical time-shutter for exposure-times ranging from 1,5 μs to 3 ms is described. The apparatus is designed for spectrographic observations of pulsed electrical discharges which show rapidly varying spectral emissivities. For the mechanical part of the shutter we used a specially formed fast rotating disk having a slit. Triggering of the discharge is achieved by the rotating disk—in connection with photocells. Both the instant at which—after the beginning of the electrical discharge—the exposure shall begin, and the duration of exposure which will then follow can be "preselected" on a special electronic control device. All functions: rotation of the disk—ignition of the discharge—exposure—switch-off of the disk are controlled electronically. The principle and the main electronic control parts of this versatile instrument are described. Author

**N66-14095#** Atomic Energy Establishment, Winfrith (England). Radiological and Safety Div.
**A MULTIWIRE PROPORTIONAL COUNTER FOR THE DETECTION OF PLUTONIUM-239 IN VIVO**
D. Ramsden May 1965 20 p refs
(AEEW-M-526) HMSO: 2s

Work is in progress on developing counters to detect plutonium in the human lungs. The need for a low background counter for such work is discussed and the design and construction of a multiwire gas proportional counter described. The performance of the counter with different gas fillings is considered and results obtained on background, resolution, field of view and efficiency are given. Future work will consist of using the counter in conjunction with a realistic chest phantom. An estimate of the limit of detection is derived. Author

**N66-14096#** United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
**AN IMPROVED FURNACE ASSEMBLY FOR HIGH-TEMPERATURE DIFFRACTOMETERS**
T. W. Baker, W. E. Spindler, and P. J. Baldock Jul. 1965 11 p ref
(AERE-M-1361) HMSO: 3s 6d

The furnace element in a high-temperature attachment to a Philips X-ray diffractometer has been re-designed to give higher specimen temperatures and longer furnace life. The assembly and replacement of the furnace element has also been greatly simplified. Arcing, which has proved highly destructive at times, has also been eliminated. Author

**N66-14101*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GODDARD SUMMER WORKSHOP PROGRAM: MEASUREMENT AND SIMULATION OF THE SPACE ENVIRONMENT Final Report, 15 Jun.–15 Sep. 1964**
Elias Klein, comp. [1964] 288 p refs
(NASA-TM-X-55168; X-320-64-341) CFSTI: HC $6.00/MF $1.50 CSCL 14B

Papers are presented on space optics, radiation, and solar simulation; heat transfer and vacuum technology; and magnetic and electric fields in environment simulation. For individual titles see N66-14102–N66-14131.

**N66-14102*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**OPTICS AND SPECTROSCOPY IN SPACE ENVIRONMENT SIMULATION AND CALIBRATION**
M. P. Thekaekara *In its* Goddard Summer Workshop Program [1964] 4 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

Solar simulation radiometry, Tiros satellites radiometry, and the high precision instrumentation of the vacuum optical bench are discussed. Two problems concerning the Tiros satellites which are considered are the prelaunch calibration and the degradation of the radiometer when exposed to the rigors of space. In the design of the vacuum optical bench, a Cassegrainian telescopic system receives radiation from the test plane of the vacuum optical bench with a high degree of uniformity, monochromaticity, and collimation at any desired wavelength between 900 and 5000 Å. Early performance tests showed that the exacting specifications were not being met as far as uniformity of illumination was concerned. Part of the failure could be attributed to the tripartite grating which was blazed for a wavelength near Lyman-alpha. E.E.B.

**N66-14103*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**USE OF INTERFERENCE FILTERS FOR SPECTROPHOTOMETRY OF SOLAR SIMULATIONS**
Matthew P. Thekaekara and Donald Mac Kenzie *In its* Goddard Summer Workshop Program [1964] 12 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The problem of determining the short-period fluctuations in the spectral-radiant flux of solar simulators suggested the desirability of a filter technique for spectroradiometry. A multilayer interference filter was chosen which transmits energy over a narrow wavelength band and absorbs all energy outside that band. The energy transmitted by the filter is measured by a thermopile. The signals of the thermopile are entered directly into a computer program which prints out normalized values of the spectral flux for a large number of narrow wavelength bands and displays the energy distribution as a graph with wavelength on the x-axis and spectral radiant flux per unit wavelength on the y-axis. The experimental procedure and data analysis are discussed in detail. E.E.B.

**N66-14104*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EVALUATION OF A 6-FOOT SPHERICAL INTEGRATOR AS A WIDE-ANGLE SOURCE**
Eugene I. Mohr and Nathan J. Miller *In its* Goddard Summer Workshop Program [1964] 13 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The Tiros meteorological satellites contain several radiometers, one of which is a five-channel medium-resolution scanning radiometer designed to collect radiation in five wavelength bands by optically filtering the radiation. A 6-foot integrating sphere was used as a wide angle source for the calibration of the radiometer. The calibration curve shows that the output of the radiometer departs slightly from a completely linear relation with the intensity. From theoretical considerations, one would expect this relation to be completely linear. An independent calibration was made by means of diffusing white

Kodak paper illuminated by a tungsten-filament lamp. The two calibration curves are shown. Both sets of data appear to be correct within experimental error. However, data from Tiros weather satellites have given values for the earth's albedo considerably below the theoretical. Further study of the two methods of calibration is required and experimental and theoretical implications need to be re-examined. E.E.B.

**N66-14106*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**STUDIES ON THE DEGRADATION OF THE FIVE-CHANNEL RADIOMETER**
Joseph B. Morris *In its* Goddard Summer Workshop Program [1964] 10 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

A study to determine whether any chemical factors are directly or indirectly related to the observed degradation of the five-channel radiometer of the Tiros meteorological satellites is reported. It was found that all paints used on the radiometer in the Tiros satellites outgas under reduced pressure at 100°C. Based on reflectance and transmission measurements, a predicted decrease in the transmission of radiant energy throughout the entire spectral region was verified and this experimental decrease agreed closely with what was actually observed in all channels of the Tiros radiometers and in all spectral ranges except a narrow band centered at 0.375 microns. Because outgassing appears to be rate-controlled, it seems that the effect does have some correlation with the general phenomenological degradation of signals from the radiometer. E.E.B.

**N66-14107*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**TELESCOPIC DESIGN FOR AN INTERFEROMETRIC SPECTROPHOTOMETER**
Ernest Hilsenrath *In its* Goddard Summer Workshop Program [1964] 2 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

An infrared interferometer spectrometer for the exploration of the earth atmosphere and exploration of other terrestrial-type planets, Mars and Venus, is discussed. The spectrometer is the same for both missions except that the planetary probe instrument will include a telescope. The instrument without the telescope has an acceptance of 8°. Therefore, for a satellite such as Nimbus, the instrument would cover an area about 100 km across at the surface of the earth. However, the 8° acceptance angle is too large for a planetary flyby. The Mars probe is expected to pass about 5000 km from the planet. To cover 250 cm on the planet would require that the acceptance angle of the instrument be reduced to 2.8° and this is the purpose of the telescope. The interferometer spectrometer and the telescope are described and the optics of the system is shown. The obscuration of the telescope is about 12%. E.E.B.

**N66-14108*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE FOURIER TRANSFORM IN INTERFEROMETRIC SPECTROPHOTOMETRY**
Robert L. Sharp and Matthew P. Thekaekara *In its* Goddard Summer Workshop Program [1964] 9 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

One of the sources of distortion of the interferogram is caused by the finiteness of the path-length difference. The effect on the Fourier transform spectrum G'(w) of changing the observed interferogram I'(x) to any other arbitrary interferogram I''(x) is examined. From an assumed value of the weighted interferogram G''(w) the interferogram I''(x) can be obtained by numerical integration. A Fourier transform is made of I''(x) to give a closer approximation to the true spectrum G(w). An iteration process will further reduce the mean-square error. E.E.B.

**N66-14109*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE VACUUM OPTICAL BENCH AND PRECISION MEASUREMENT OF ANGLES**
Matthew P. Thekaekara, Stephen M. Shapiro, John C. Morrison, and Robert Appler *In its* Goddard Summer Workshop Program [1964] 31 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The vacuum optical bench is essentially a system of reflecting optics in a vacuum chamber. It is a testing facility for the optical packages of the Orbiting Astronomical Observatory program. The experimental packages may be a single large aperture telescope or several small optical systems mounted side by side in a satellite. The vertical optical bench can test at one time an experimental package with an aperture as large as 38 inches in diameter for the incoming light. The optical bench is described and calibration tests and measurements with the Midarm model 14 autocollimator are presented. Also, the calibration of the angle-generator using a laser beam and a gravity-reference system for precise alignment of instruments are discussed. E.E.B.

**N66-14110*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE ILLUMINATING SYSTEM FOR THE VACUUM OPTICAL BENCH**
Irvine C. Gardner *In its* Goddard Summer Workshop Program [1964] 4 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The vacuum optical bench is essentially a very large collimator system mounted in a vacuum chamber. The beam of parallel light of large diameter that is produced is intended to simulate a beam of the character that an optical instrument carried by a satellite will receive from a star when in outer space. The spectral range to be provided extends from 5000 to 900 Å. The earth's atmosphere limits the radiation received on earth from celestial bodies to wavelengths greater than 3000 Å. As the wavelength becomes shorter than this value, the experimental difficulties increase. For wavelengths shorter than 1800 Å, the air absorption becomes important. For wavelengths shorter than 1200 Å there is no known solid that is transparent. Hence, all control of the course of rays must be by reflecting elements and there can be no solid material to separate the interior of the electron-discharge tube serving as a source of light from the optical system. A beam of parallel light of large diameter is required because some of the optical systems to be tested have large apertures. There is also a requirement to isolate from any part of the spectral range the radiation having a bandwidth no greater than 1 Å. These problems are considered for the illuminating system for the vacuum optical bench. E.E.B.

**N66-14111*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ROLE OF CRYOSORPTION IN ULTRAHIGH-VACUUM SYSTEMS**
J. E. A. John *In its* Goddard Summer Workshop Program [1964] 3 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

In a vacuum chamber capable of maintaining pressures of $10^{-14}$ torr in the presence of a test object, high pumping speeds are required at high vacuum to handle both gases initially present in the chamber and those outgassed during the test.

Provisions must also be made to reduce the gas leak rate to a low level. Cryogenic pumping seems best for this application because it provides high pumping speeds and the volumetric pumping speed is independent of pressure. Further, large pumping surfaces can be provided, the cryogenically cooled walls acting as pumping area. Disadvantages of cryogenics are the expense involved; the cost of operating a liquid helium system at 4.2° K being almost prohibitive. Also, only condensable gases can be pumped. Cryosorption refers to the adsorption of certain gases on cryogenically cooled surfaces. Several adsorbants have a great affinity for hydrogen when cooled to 20° K and below. The design of a ultrahigh vacuum facility using cryosorption is described and some of the problems of cryosorption are considered. E.E.B.

**N66-14113*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**SPACECRAFT AUXILIARY THRUST SYSTEM: PERFORMANCE-MEASURING TECHNIQUES**

J. M. Bridger *In its* Goddard Summer Workshop Program [1964] 2 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The advent of the stabilized spacecraft has brought with it totally new requirements for thrusting devices. These new requirements include very low thrust levels; periodic operational modes involving very short on-times; long lifetimes; rigorous repeatability; no leakage; and operation in an environment including hard vacuum, extremely low temperatures, and high radiation and particle fluxes. To illustrate the magnitude of the task of evaluating thrustors operating in the millipound range, typical ranges of performance required for attitude stabilization and station-keeping of a synchronous satellite are considered. A vibration survey of the 4- by 5-ft thermal-vacuum space simulator was made. Measurements were taken on an overhead T section and on the shroud rails where experiment installations are mounted. Measurements in three dimensions were made at the door end and at the middle of the chamber with various combinations of exciting equipment in operation. The maximum acceleration observed on the shroud rails was at 60 cps. Vibrations were observed also at lower amplitudes in other frequency ranges. A survey of the data indicated some dependence of the accelerations on the phases of the different exciting equipments. E.E.B.

**N66-14118*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**PROCESSES IN HOT-CATHODE IONIZATION GAUGES (IN REFERENCE TO EXPLORER XVII)**

F. M. Propst *In its* Goddard Summer Workshop Program [1964] 3 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The anomalous processes that can take place in a hot cathode ionization gauge are reviewed. Anomalous processes are considered as those in which any current collected at or leaving the collector of an ion gauge is not proportional to the volume density of gas. When the cathode is heated, the emission of electrons, ions, neutral particles, and photons occurs. All phenomena, both normal and anomalous can be predicted by following the interaction of these particles with the surfaces and volume gas in the gauge. As an example the history of the electrons emitted from the cathode is traced and the anomalous processes which can occur are examined in detail. Also, these processes are graphically shown. The complexity of the processes in an ionization gauge is illustrated and the method for the prediction of these processes is demonstrated. E.E.B.

**N66-14119*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**MEASUREMENT OF OUTGASSING FROM SPACECRAFT**

F. Owens and Y. Chen *In its* Goddard Summer Workshop Program [1964] 14 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

An investigation was made to determine the gas evolution pattern from a spacecraft, commonly referred to as outgassing. Also, the necessary instrumentation was evaluated with emphasis on operating procedures and on methods of data acquisition and data analysis. The results showed that there is considerable outgassing from a spacecraft in a vacuum chamber. This fact established the basis of using outgassing measurements as diagnostic tools. The mass spectrometer as an instrument capable of giving an order-of-magnitude determination of the residual gases inside a test chamber was also investigated. The spectrometer can detect certain equipment failure aboard the spacecraft, i.e., a sudden increase in the peak of a gas might indicate a leak such as a battery or pressurized recorder. The nature of component degradation can also be studied by an outgassing analysis. Further, in space simulation, the evolving gases very often return to the spacecraft because of the rebound effect. Here the identity of the gases can provide useful information. E.E.B.

**N66-14121*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**APPLICATION OF CERAMIC-FIBER PAPER TO UHV TRAPS**

F. M. Propst *In its* Goddard Summer Workshop Program [1964] 2 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

A ceramic paper has been applied to the construction of refrigerated and nonrefrigerated traps and baffles for high- and ultrahigh-vacuum systems. The paper is approximately 51.2% $Al_2O_3$ and 47.1% $SiO_2$ with small amounts of other materials. The paper has a felt-like texture and a large trapping area-to-volume ratio. The alumina and silica are very stable and can be fired to high temperatures without decomposition. Two of the baffles which can be constructed from this paper are shown. The ceramic paper is prepared for the baffles by firing in air at 1000° to 1200° C for 5 to 25 min. The performance of two vacuum systems using this paper in the traps was found to be excellent. One system using a trap similar to the one illustrated and pumped by a glass two-stage oil-diffusion pump produced pressures of about 3 to $5 \times 10^{-12}$ torr with the trap cooled to liquid nitrogen temperatures. This same system produced pressures of about 1 to $2 \times 10^{-11}$ torr with the trap at room temperature. Also, preliminary work was performed using this paper as a filter in the pumping lead. The results of this test were encouraging in that the pumping speed through the paper was reasonably high and pressures in the $10^{-10}$ torr region were obtained. E.E.B.

**N66-14122*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**FOUR-CIRCULAR-COIL SYSTEMS**

S. H. Saperstone *In its* Goddard Summer Workshop Program [1964] 4 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

In order that the current in both coil pairs of the four-circular-coil system be the same, it is necessary that the turns-ratio $N_2/N_1$ be a rational valued quantity. A computer program was written to determine the parameters of the system for specified rational values of $N_2/N_1$. By specifying the ratio, the coil spacing and radius of each of the coils are automatically determined. The results are tabulated. As the turns-ratio decreases, the larger #1 coils are moving away from the center

of the system, the smaller #2 coils are moving toward the center of the system, and the radius of the #2 coils is decreasing. Another computer program was written to calculate the flux density components of the coil system. The axial component of the flux density plotted on an X-Y plotter for the system with the one-to-one turns-ratio are shown as contours. E.E.B.

**N66-14123*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**FOUR-OCTAGONAL-COIL SYSTEMS**
S. H. Saperstone *In its* Goddard Summer Workshop Program [1964] 10 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

In the production of uniform magnetic fields, the regular octagonal-coil system is a compromise between the square-coil and circular-coil systems. The parameters of the coil system for specified rational valued turns-ratio were calculated and these values were used to determine the field gradients. A computer program was written to calculate the parameters of the four-coil system and the results for the octagonal coil systems with rational turns-ratio are tabulated. Also, a computer program was written to trace contour lines of constant field intensity for the turns-ratios tabulated. Details of this analysis are included. E.E.B.

**N66-14124*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**APPROXIMATION METHODS FOR OBTAINING UNIFORM MAGNETIC FIELDS**
S. H. Saperstone *In its* Goddard Summer Workshop Program [1964] 4 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

It has become necessary to study methods of enhancing the volume of homogeneity of the magnetic field produced by circular coils. Present techniques demand very large coil systems for a corresponding increase in the volume of uniformity. The methods of approximation theory were applied to the uniformity problem in an attempt to show that results significantly better than those obtained with established techniques can be calculated. The least squares method was tried; however, results were unsuccessful. Also, the Chebyshev approximation was applied to the two-circular-magnetic-coil problem. Though no conclusive results were obtained, an indication of how this problem must be attacked was prepared. E.E.B.

**N66-14125*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LARGE MAGNETIC ENVIRONMENTS**
R. Piziali and D. L. Waidelich *In its* Goddard Summer Workshop Program [1964] 13 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

To determine the magnetic properties of a large satellite, it is necessary to set up a coil system which can cancel or nearly cancel the earth's magnetic field throughout the volume of the satellite. A number of possible coil systems were investigated with the object of obtaining a 5% variation of the field over the volume of the satellite. The Pegasus meteoroid detection satellite was chosen for the analysis. Two- and four-dipole systems; finite-size four-coil system; two square coils; two rectangular coils; dipole arrays; and one coil, two dipole configurations were considered. E.E.B.

**N66-14127*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEASUREMENT OF SMALL MAGNETIC TORQUES: PARALLEL PLATE METHODS**
D. L. Waidelich *In its* Goddard Summer Workshop Program [1964] 4 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

A project proposed was to float a spacecraft on water and measure the torque exerted on the craft by the earth magnetic field. This torque was expected to be very small, of the order of 10 to 10000 dyne-centimeters. The problem considered was the provision for a torque in the opposite direction that would stabilize the whole system so that the original torque could be measured. One way to provide such a torque is to use parallel plates with a voltage between the plates such that the resulting force between the plates would supply the restoring torque. Such a circuit is shown. Also considered is the three-plate arrangement. The middle plate is assumed to be movable by reason of the forces exerted from each outer plate. This system is discussed in the light of the unstable equilibrium for the system. E.E.B.

**N66-14128*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEASUREMENT OF SMALL MAGNETIC TORQUES: DIELECTRIC-PLATE, PIEZOELECTRIC, AND ELECTRET METHODS**
A. V. Dralle *In its* Goddard Summer Workshop Program [1964] 4 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

Three devices are discussed for the measurement of a small torque on a suspended body. These are the dielectric plate, piezoelectric crystal, and electret. Energy considerations show that a dielectric plate of a shape similar to the plates of a parallel-plate capacitor is in stable equilibrium when centered within the capacitor. When the dielectric is displaced from its center position it is acted on by a restoring force tending to return it to the equilibrium position. A piezoelectric crystal has the property of developing voltages across its volume upon the application of mechanical stress. The electret is a dielectric crystal with the property of being permanently electrically polarized along a single direction. An important consequence of its polarization is the presence of a surface charge on the end faces normal to the polarization direction. This charge may be as large as 3 esu/cm$^2$. The use of these three devices is demonstrated for the measurement of small torques on a suspended body. E.E.B.

**N66-14129*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEASUREMENT OF ELECTRIC-FIELD INTENSITY**
D. L. Waidelich *In its* Goddard Summer Workshop Program [1964] 3 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

Working with electrostatic fields requires a method of measuring electric-field intensity. Various methods for measuring the field intensity at the surface of the earth or at heights attainable by aircraft and balloons are discussed. The use of antenna, probe, field mill, and vibrating charged probe are considered. Several field mill experiments have been flown in rockets and satellites. Difficulty was experienced in all these measurements because the plasma sheath about the instrument effectively shielded the instrument from the outside electric field. An attempt to separate the effects of the plasma sheath and the electric field was made by the use of two frequencies in a field mill. A problem closely connected with that of measuring the electric-field intensity is that of determining the electric potential of a satellite. A computer solution and two model experiments were made on this problem. E.E.B.

**N66-14131*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**INTERACTION OF MAGNETIC AND ELECTRIC FIELD MEASUREMENTS**
A. V. Dralle *In its* Goddard Summer Workshop Program [1964] 2 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The problem of measurement of electric fields by an observer traveling through a magnetic field or the measurement of a magnetic field by an observer passing through an electric field is discussed. A magnetic field as large as 4 gammas may be induced by motion of an instrument at 40 km/sec through an electric field of $10^4$ V/m. Similarly, an electric field of 0.3 V/m is induced by motions of an instrument at 8 km/sec in a magnetic field of 0.5 gauss. To produce a measurement of 1 gamma by motion of a magnetometer with velocity V through a purely electric field E, the condition $VE = 10^8$ V/m must be met. E.E.B.

**N66-14140#** Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
**INSTRUMENTAL DISTORTION OF BETA SPECTRA MEASURED IN AN INTERMEDIATE-IMAGE SPECTROMETER**
Helmut Paul [1965] 39 p refs
(SGAE-PH-21/1965) CFSTI: HC $2.00/MF $0.50

Following an earlier publication in which the properties of an ideal magnetic spectrometer were discussed, this paper describes the distortions of continuous spectra that can occur in a real spectrometer. Properties and adjustment of an intermediate-image spectrometer are discussed, and the magnification is shown to be roughly unity. Corrections for source thickness, for backscattering from the source backing and from the scintillation detector, for source-independent background, and for source-dependent gamma and electron background are discussed. Methods for checking the magnetic field and limits are given for possible distortions due to magnetic field defects, to insufficient vacuum and to scattering from baffles. The anisotropy of a thick source due to multiple scattering is calculated in an approximate way. The resolution correction factor derived previously is presented in a more convenient form and compared with experiment. Author

**N66-14159*#** Athey (Skipwith W.), Palo Alto, Calif.
**MAGNETIC TAPE RECORDING**
Skipwith W. Athey Washington, NASA, Jan. 1966 327 p refs (Contract NASw-945)
(NASA-SP-5038) GPO: HC $1.25; CFSTI: MF $1.75 CSCL 14C

A technological survey of the field of magnetic tape recording is presented. Discussed are recording methods, the elements of the tape recorder, head-tape interaction, tape moving systems, disturbances to tape motion, magnetic tape, and recorder electronics. Also discussed are the structure and function of tape recorder heads, tape recorder mechanical components, methods of testing and evaluating tape and recorders, miniature high-environment recorders, complete recording systems, and utilization factors in magnetic recording. Photographs, diagrams, and graphs are given in support of the survey material. L.S.

**N66-14225*#** Consolidated Controls Corp., Bethel, Conn.
**PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Sixth Quarterly Report , Jun. 1–Aug. 31, 1965**
Anthony J. Cassano 18 Oct. 1965 115 p refs
(Contract NAS3-4170)
(NASA-CR-54763) CFSTI: HC $4.00/MF $0.75 CSCL 14B

Continuing development of a thermionic diode pressure transducer for liquid metal applications is described. Two test models were fabricated and installed in the vacuum test facility. One of the models incorporated the C-129Y double convolution pressure capsule previously tested using the optical technique. A cross-sectional cut was made of the representative Nb-1Zr/Lucalox seal which recently underwent life testing. Analysis of the cross-section indicates that seals fabricated by this technique will meet the performance requirements for temperature and internal pressurization. The 500 hour potassium compatibility test was completed. After the test, the four test pressure capsules were found to be still leak tight. Metallographic examination showed no evidence of potassium attack in the capsule interior. Initial work on the transducer signal conditioning equipment established the various functional blocks of the system. The differential pressure transducer effort was concentrated on experimental work involving the force-deflection and frequency response characteristics of a representative mechanical linkage. Author

**N66-14249#** Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Elektronik Institut.
**UNIVIBRATOR AS A TIME BASE ELEMENT IN A MEDIUM FAST COINCIDENCE CIRCUIT**
H. Halling and F. May Sep. 1965 18 p Submitted for Publication
(SGAE-E-5/1965) CFSTI: HC $1.00/MF $0.50

In a medium fast coincidence circuit (resolution time variable from 100 nsec–11 μsec) a univibrator is used as timing element (delay and determination of resolution time). The univibrator is designed to have a constant but adjustable output pulse width. Author

**N66-14297*#** Fairchild Camera and Instrument Corp., Syosset, N. Y. Systems Management and Engineering Dept.
**CAMERA AND FILM PROCESSOR Final Engineering Report**
G. L. Haines 12 Aug. 1965 110 p Prepared for JPL
(Contracts NAS7-100; JPL-950794)
(NASA-CR-68973; SME-AF-22) CFSTI: HC $4.00/MF $0.75 CSCL 14E

Specifications and the engineering proposal are presented for implementing the mechanization of the film expose, transport process portion of a photographic film system which acts as its own data storage system. This system would be capable of high resolution photographic reconnaissance of the Martian surface from an orbiting spacecraft, and of performing both the long term storage and the photo sensing functions. The design analysis is included, and details are given on the various modes of operation available and the theory of operation of the various components in each mode. Operation and maintenance information is outlined, and an electrical schematic is presented on the camera film processor. M.G.J.

## 15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

**N66-13338*#** North American Aviation, Inc., Los Angeles, Calif.
**NONDESTRUCTIVE TESTING THEORY AND APPLICATION FOR COMPOSITES Bibliography**
15 Oct. 1965 219 p
(Contracts NAS8-11733; AF 33(615)-2865)
(NASA-CR-68604; NA-65-813) CFSTI: HC $6.00/MF $1.25 CSCL 05B

A comprehensive literature survey was conducted as one phase of work performed under the NASA and Air Force contracts identified in the Foreward. Literature relating to nondestructive testing theory, techniques and equipment was collected and indexed. Material relating to ultrasonics and ultrasonic testing equipment and techniques was of primary interest, however other fields of nondestructive testing are also included in the survey. Related subject material concerning honeycomb and sandwich contruction, composites, and bonding, are included to provide helpful background information. Author

**N66-13404*#** Boeing Co., Seattle, Wash.
**FABRICATION OF LIGHTWEIGHT PARABOLIC CONCENTRATORS FROM A GLASS MASTER Final Report**
R. B. Gillette and H. E. Snyder 12 Sep. 1963 20 p refs
(Contract NAS7-165)
(NASA-CR-51732; D2-20150-1) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Significant refinements are reported in the fabrication of a high optical quality, lightweight solar concentrator by using a five-foot diameter glass convex master as the reference optical surface. A new spraying technique was used to form multiple layers of epoxy resin for the optical substrate, together with aluminum honeycomb, and fiberglass cloth. Several 8 inch diameter specimens and a 1/3 scale model concentrator were obtained with intact substrates. The epoxy filled substrate of a 60 inch diameter concentrator cracked while curing due to the developing tensile stresses between the filled epoxy and the glass master. It was concluded that a lower curing temperature might eliminate cooling stresses. G.G.

**N66-13426#** Esso Research and Engineering Co., Linden, N. J. Products Research Div.
**LUBRICITY PROPERTIES OF HIGH-TEMPERATURE JET FUELS Quarterly Progress Report, 15 May–15 Aug. 1965**
J. K. Appeldoorn, R. J. Campion, W. G. Dukek, M. J. Furey, and F. F. Tao [1965] 45 p refs
(Contract AF 33(615)-2828)
(QPR-1; AD-472148)

This is the first quarterly report of work to study the lubricity properties of jet fuels. A field survey of engine and pump manufacturers indicates there is a potential problem when pumping jet fuels, particularly at high pressures, high temperatures and when using highly-purified fuels. Problems in the field include wear, scuffing, sticking, seizure, and fatigue pitting. Laboratory tests on pure hydrocarbons in the jet-fuel boiling range indicate that viscosity is beneficial in reducing wear and friction, but that chemical structure also has some effect. The addition of typical sulfur and nitrogen compounds, surprisingly, gave no reduction in wear and friction. In a vane pump test, a high-purity kerosene gave very excessive wear; adding 1% of a special lubricity additive essentially eliminated the wear. Author (TAB)

**N66-13532#** Institut Franco-Allemand de Recherches, St. Louis (France).
**FUNDAMENTAL STUDIES OF THE COLD HAMMERING OF ARMOR PLATE THROUGH INITIAL STRESS BY MEANS OF EXPLODING [GRUNDSATZLICHE UNTERSUCHUNGEN UBER DIE VERFESTIGUNG VON PANZERPLATTEN DURCH VORBLLASTUNG MITTELS SPRENGUNGEN]**
H. G. Otto and C. Jessen 4 Jul. 1963 35 p refs In GERMAN
(ISL-T-13/63) CFSTI: HC $2.00/MF $0.50

Metallurgic impact hardening methods were reviewed and discussed, and their application to steel armor plates possessing a high degree of hardness was evaluated. A nickel-chrome-molybdenum steel was subjected to weak detonation shocks produced by combustible adhesive foils. Minimal increases in hardness effect were observed. The usual structural defects caused by detonations on steel were almost completely absent. Transl. by G.G.

**N66-13627#** Pratt and Whitney Aircraft, Middletown, Conn.
**CAVITATION SENSITIVE COATING EVALUATION**
G. Noell 29 Jun. 1965 45 p
(Contract AT(30-1)-2789)
(TIM-878) CFSTI: HC $2.00/MF $0.50

A summary of tests conducted on surface coatings that can be applied to an impeller in order to locate probable areas of cavitation damage are presented. Various coatings of epoxies, paints, dyes, and platings were tested using a rotating disk with inducer holes as a cavitation producing device. Tests were conducted in demineralized, degassed water at 90 to 100° F. Coating materials were applied to the stainless steel disk and these coatings were screened for their adhesion qualities, response time and the degree of definition. The results indicated that gold acrylic lacquer spray, when applied to a cleaned and degreased surface, produced cavitation damage indications under ten minutes test time. Author (NSA)

**N66-13671#** Rocky Flats Div., Dow Chemical Co., Golden, Colo.
**STRAIN GAGE APPLICATIONS USING THE ROKIDE PROCESS**
L. J. Anderson 20 Aug. 1965 10 p Presented at 9th Meeting, IMOG Subgroup on Environmental Testing, Amarillo, Tex., 14–15 Sep. 1965
(Contract AT(29-1)-1106)
(RFP-641; Conf-650926-1) CFSTI: HC $1.00/MF $0.50

The Rokide process was developed for attaching strain gages to certain materials under unusual conditions such as high temperature. The advantages and disadvantages of the flame-spraying process are outlined, and the equipment and stages in attaching a strain gage are described. NSA

**N66-13673#** Atomic Energy of Canada Ltd., Chalk River, Ontario.
**HIGH PRESSURE ROTARY FACE-TYPE SHAFT SEALS FOR WATER APPLICATIONS**
R. D. Watson Dec. 1964 25 p refs
(AECL-2249) CFSTI: HC $1.00/MF $0.50

Information resulting from development work performed by AECL was used to explain the operation and failure of rotary face-type shaft seals in high pressure water. Several types of hydrostatic and hydrodynamic seals were investigated and two, the orifice-type controlled leakage hydrostatic seal and elliptical seal, show great promise for the future. A number of different combinations of materials were used in testing shaft seals, but not one has proved entirely satisfactory. Author (NSA)

**N66-13867#** Battelle-Northwest, Richland, Wash.
**A HIGH TEMPERATURE TENSILE TESTING MACHINE FOR IRRADIATED STRUCTURAL MATERIALS**
R. Teats and E. C. Watts Jul. 1965 10 p Presented at the 13th Conf. on Remote Systems Technol., Washington
(Contract AT(45-1)-1830)
(BNWL-SA-169; Conf-651101-31) CFSTI: HC $1.00/MF $0.50

A tensile testing system was put into service that is capable of testing irradiated metals at temperatures up to 3000° F. The testing machine, enclosed in a cast iron shielded cell, is equipped with a water-cooled high-vacuum furnace using tantalum strip heating elements. Grips were designed that have successfully held both flat and button head specimens and yet are simple enough to be assembled remotely using a single manipulator. Stress-strain data from a remote extensometer and a load cell are recorded on an XY recorder. Author (NSA)

**N66-13882#** Joint Publications Research Service, Washington, D. C.
**PLOTTING THE PERFORMANCE CURVES OF A SCREW PROPELLER BY MEANS OF DIGITAL COMPUTERS**
F. M. Katsman 2 Dec. 1965 13 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 5, May 1963 p 9–12
(JPRS-33131; TT-65-33707) CFSTI: $1.00

A computational method based on the use of familiar relationships of the vortex theory is proposed for plotting performance curves of a screw propeller using a high speed digital computer. The accuracy of the proposed method was verified by comparing the results of calculations of Troost series propellers on the Ural-2 computer with the results of model tests. Computations of the performance curves for five to six propellers with the same disc ratio and the same number of blades but with differing pitch were performed in 10 to 12 minutes. The initial data for the computation of a single propeller or several propellers with identical blade elements but with different pitch are prepared in less than an hour, including preparation of the punch tape with the initial data. As shown by the results of the computation of a large number of propellers, the proposed method is quite applicable for the performance of comparative analyses. R.N.A.

**N66-13898#** International Resistance Co., Philadelphia, Pa. Documented Reliability Div.
**PRODUCTION ENGINEERING MEASURES FOR HIGH RELIABILITY, FIXED, FILM, PRECISION RESISTORS Quarterly Progress Report, 1 Apr.–30 Jun. 1965**
Richard C. Wagner [1965] 20 p
(Contract DA-36-039-AMC-01461(E))
(QPR-10; AD-620923) CFSTI: HC $1.00/MF $0.50

Preproduction data for style RNR60 resistor was submitted. The Automatic Binner, Automatic Spiraller and Lead Beader were manicured and placed into operation. Delivery of the Sequential Sealer and Automatic Capper are on schedule. Those areas of the manufacturing process contributing to excessive cost are studied and evaluated, and alternative techniques aimed at reducing cost and increasing output are examined. A facility is established for the manufacture of not less than 6,000 combined units (resistors) of Mil-R-55182 styles RNR55C, RNR60C and RNR65C and 1500 units of style RNR57C per eight hour day single shift. TAB

**N66-13905#** California Univ., Berkeley. Lawrence Radiation Lab.
**X-RAY EXAMINATION OF SQUARE WATER-COOLED COPPER MAGNET-CONDUCTOR BRAZE JOINTS**
Richard A. Nickerson 1 Sep. 1965 11 p Presented at the 1st Intern. Symp. on Magnet Technol., Stanford, Calif.
(Contract W-7405-ENG-48)
(UCRL-16383; Conf-650922-11) CFSTI: HC $1.00/MF $0.50

Brazed joint design and fabrication technology was improved by X-ray quality control in early stages of magnet coil production. The X-ray techniques discussed, though simple, require consideration of geometry and of exposure parameters, particularly kilovoltage. A method is described for proper choice of exposure kv, which permits the high-quality radiographs needed for quality control. The joint design which proved to be most reliably manufactured (when a rigidly controlled process is followed) is discussed. Author (NSA)

**N66-13932#** Joint Publications Research Service, Washington, D. C.
**SELF-ADJUSTED PROGRAMMED MACHINE-TOOL CONTROL SYSTEM [SAMONASTRAIVAYUCHSHAYASYA SISTEMA PROGRAMMNOGO UPRAVLENIYA STANKAMI]**
A. Ye. Kobrinskiy, A. Sh. Koliskor, Ye. I. Levkovskiy, V. Ye. Popov, and V. I. Sergeyev 8 Dec. 1965 9 p Transl. into ENGLIGH from Vestn. Akad. Nauk SSSR (Moscow), no. 9, Sep. 1965 p 52–56
(JPRS-33229; TT-65-33804) CFSTI: $1.00

A discussion is given of digital program controlled machining. Various methods are described, and specific examples are cited. Emphasis is placed on self-adjusted machine tool control systems, and programs for realizing this control. An optimum method is described along with algorithms for searching for a concrete technological process. C.T.C.

**N66-13934#** Pratt and Whitney Aircraft, Middletown, Conn.
**CENTRIFUGAL PUMP IMPELLER DESIGN SYSTEM**
R. P. Lamers 24 Jun. 1965 58 p refs
(Contract AT(30-1)-2789)
(TIM-918) CFSTI: HC $3.00/MF $0.75

A summary is presented of the centrifugal pump impeller design system developed at CANEL. The system includes an analysis-design effort and a fabrication-inspection effort. The system is part of the technology which has been developed for the design and development of high speed turbomachinery for pumping high temperature liquid metals. Author (TAB)

**N66-13935#** Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.
**FABRICATION OF CALORIMETER ELEMENTS Completion Report**
J. F. Mc Laughlin, T. A. Nolan, T. G. Burke, and W. J. Wilcox, Jr. 29 Jan. 1965 73 p refs Prepared for Sandia Corp.
(Contract W-7405-ENG-26)
(KL-1944) CFSTI: HC $3.00/MF $0.75

A process was developed for fabrication of a calorimeter element using a nickel resistance path. The element has a reproducible temperature coefficient of resistance in the temperature range 75 to 200° F. The process consists of the following steps: machining of the substrates, cleaning, anodizing, sealing of the anodized layer, evaporation of the resistance path, attachment of electrical leads, sealing of the resistance path, and testing procedures. Several materials were used as substrates for the calorimeters in the development program. Tantalum was the most extensively used material, and glass, aluminum, and fiberglass laminate were also employed. Several different metals were investigated for use as resistance paths. They were: tellurium, nickel, platinum, copper, iron, and chemically deposited nickel. Tellurium elements were not satisfactory because of their erratic behavior. Platinum could

be used if the resistance paths were sealed from the atmosphere, but is has the lowest temperature coefficient of resistance of any of the materials studied. Copper films were not extensively studied, but electrical measurements disclosed some short-term noise. All efforts to make an iron calorimeter failed. Electroless nickel films exhibit a somewhat erratic behavior. Vacuum evaporated nickel films, when successfully sealed from the atmosphere, exhibit reproducible temperature-resistance curves from 75 to 200° F. The resistance of the nickel films was found to be independent of the applied current in the range 0.1 ma to 4.0 ma. Author (NSA)

**N66-13996#** Joint Publications Research Service, Washington, D. C.

**PRODUCTION METHODS OF MEASURING SCREW PROPELLER PITCH**

F. M. Katsman and G. M. Kudrevatyy 8 Dec. 1965 12 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 3, Mar. 1957 p 47–51

(JPRS-33232; TT-65-33807) CFSTI: $1.00

Various devices for measuring the pitch of a screw propeller are discussed. It is noted that the permitted value of measuring device tolerance is lowered more than usual when measuring narrow-blade screws with small diameters and with corresponding reduction of the central angles between the measurement points. The use of a portable coordinate pitch gauge with a small diameter ring; the use of an angle-measuring device (inclinometer); and the use of tangent meters for measuring screw pitch are discussed, along with a method using a flexible ruler for measuring the arc area. The principle of optical measurement methods used for analyzing the precision of production errors occurring in the manufacturing process are also discussed. The advantages and disadvantages of recording type devices for measuring the pitch gauge are given. L.S.

**N66-14040#** European Atomic Energy Community, Brussels (Belgium).

**FLANGE CONNECTIONS FEATURING AN INSULATING SEALING ELEMENT [FLANSCHVERBINDUNGEN MIT STROMISOLIERENDEM DICHTUNGSKORPER]**

W. Schupp 1965 9 p refs In GERMAN; ENGLISH summary

(EUR-2434.d) CFSTI: HC $1.00/MF $0.50

For the operation of test circuits for the examination of heat transfer on tubes and tube bundles with organic coolants or pressurized and boiling water, direct electrical heating is used. This means that the heated test section, must be insulated against the whole circuit. Test circuits operate at approximately 50 atm and 450° C (organic coolants), resp. at 250 atm and 450° C (boiling and pressurized water). The construction described resolves the above problem by means of two ceramic rings ($Al_2O_3$), the inner ring serving as insulator and as gasket against the coolant. The results achieved with it have been satisfactory up to this date. Author (NSA)

**N66-14061*#** Pratt and Whitney Aircraft, East Hartford, Conn.

**BRAYTON-CYCLE TURBOMACHINERY ROLLING-ELEMENT BEARING SYSTEM First Quarterly Report, Jul. 2–Oct. 2, 1965**

H. Means Oct. 1963 74 p refs

(Contract NAS3-7635)

(NASA-CR-54785; PWA-2713) CFSTI: HC $3.00/MF $0.75 CSCL 13I

The potential of oil lubricated rolling element bearings for the Brayton-cycle space power machinery was investigated. A basic bearing-seal lubrication, scavenge, and separation system concept adaptable to the machinery developed was evolved. Mechanical design work was initiated on the turbine compressor and the turboalternator to replace the gas bearing rotor support system with an oil lubricated rolling element bearing system. A detailed design analysis was made to define the geometry of the rolling element bearings for the turbine compressor. Lubricant evaluations were initiated to form a basis for selection of the optimum lubricant for the Brayton-cycle turbomachinery. The effects of oil contamination of the working fluid (argon) were studied to establish limiting oil contamination criteria. R.W.H.

**N66-14222#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CLUTCH FOR TRANSMITTING ROTARY MOTION INTO AN AIR-TIGHT HOUSING**

N. I. Tseytlin and M. V. Repkin 21 Sep. 1965 5 p Transl. into ENGLISH from Russian Patent no. 836421/25-8, 17 May 1963 1 p

(FTD-TT-65-519/1+2+4; AD-622373) CFSTI: HC $1.00/MF $0.50

A clutch is described for the transmission of rotary motion into a hermetically sealed cavity, which contains a diaphragm, a driving and a driven half clutch, which has the distinguishing feature that for the purpose of assuring the transmission of rotary motion into a cavity of superhigh pressure a blank wall is designed in the form of a thin-walled tube consisting of concentric sections of thin-walled tubes with varying optimum differences of pressure. TAB

**N66-14251*#** General Dynamics/Convair, San Diego, Calif.

**ONSET OF CREEP STRESS MEASUREMENTS IN METALLIC MATERIALS. CREEP TEST MACHINE CONSTRUCTION AND OPERATION**

C. W. Alesch Mar. 1965 221 p Revised

(Contract NASw-491)

(NASA-CR-68966; GDC-64-213) CFSTI: HC $6.00/MF $1.25 CSCL 13H

Detailed construction and operation is described for an apparatus which extends creep deformation resolutions for measuring small amounts of creep in threshold regions of metallic materials. It relies in large degree on close temperature control for the almost complete elimination of thermal expansion transients from creep deformation measurements, and is intended for accurate and reproducible application of loads which remain constant over long periods of time. It is also intended for the measurement of very small creep deformation, and uses high resolution strain gaging for this purpose. The construction is massive and conservative in design to preclude machine deformations. Results of tests and calibration are included. C.T.C.

**N66-14285*#** Boeing Co., Wichita, Kans. Airplane Div.

**COMPOSITE BULKHEAD FABRICATION DEVELOPMENT Final Report**

Raymond F. Cox Nov. 1965 77 p

(Contract NAS8-11900)

(NASA-CR-68984) CFSTI: HC $3.00/MF $0.75 CSCL 13H

The production and evaluation of a composite bulkhead, based on a fabrication concept using vacuum and/or autoclave pressure to hold preformed sandwich elements in place during age forming and adhesive bonding, are described. Also discussed are the design and fabrication of a concave forming and aging tool in which the aluminum alloy sandwich face sheets could be final sized during aging. The bulkhead was designed and fabricated from 2219 aluminum alloy

skins chem-milled on one side only to a .060 inch thickness except in the weld land areas where they were .090. Details are given on assembly of the outer skin by welding, concave forming, and age forming; bonding of the honeycomb core to the outer skin; and final forming of the inner skin. The completed assembly was evaluated by empirical analysis, radiographic inspection, destructive testing, and visual inspection. Results indicate that aluminum alloy 2219 can be preformed and subsequently age formed to tolerances required for adhesive bonded honeycomb sandwich structures. M.G.J.

**N66-14309#** Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
**TRANSPARENT FLEXIBLE HEAT SEALABLE FILMS—EVALUATION OF ABILITY TO PROTECT AGAINST CORROSION**
Richard Murrens Jun. 1965 18 p
(RIA-65-1588; AD-623300) CFSTI: HC $1.00/MF $0.50

Ten different transparent plastic films were evaluated for their ability to provide protection against corrosion to steel panels with and without preservation in an accelerated humidity environment. The films represented water vapor transmission rate (WVTR) values currently required by military specifications. Results showed that films with low WVTR values did not prevent the entrance of water vapor, which resulted in corrosion. Prevention against corrosion was maintained for extended periods of time only when preservatives were used. Author (TAB)

# 16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

**N66-13349*#** h nu systems, inc., Palo Alto, Calif.
**[DEVELOPMENT OF HIGH SPECIFIC POWER He-Ne LASERS] Final Report**
Richard S. Reynolds 29 Oct. 1965 50 p refs
(Contract NAS8-11613)
(NASA-CR-68589) CFSTI: HC $3.00/MF $0.50 CSCL 20E

This report covers the work performed in the development of two high specific power He–Ne lasers designed to operate in conjunction with optical tracking systems at 6328 Å only, with an objective of 50 mw single mode power output in a length of 50 cm maximum. The report discusses the areas of major study and indicates the areas of major accomplishments. Also discussed in detail are the areas requiring further refinements. Recommendations and conclusions based on the experience and results obtained are also listed. Author

**N66-13462#** Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
**UNSTABLE OPTICAL RESONATORS**
Walter K. Kahn Sep. 1965 30 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1290-65; AD-471936)

A technique, firmly based on a development from ray optics, is presented for calculating the loss due to the finite sizes of curved mirrors when these form an unstable optical resonator. If paraxial rays launched within such a resonator are confined near the resonator axis, the resonator is termed stable; otherwise it is termed unstable, and is known to have high losses. Siegman has recently presented a geometrical method, brilliantly constructed ad hoc, for calculating these losses in unstable resonators, and indicated where these might be advantageous in laser application. The ray optical theory presented here, which employs the concept of ray modes in an equivalent beam waveguide, is shown to yield results equivalent to those of Siegman for all cases considered by him. However, being derived from conventional ray optics, the validity of the formulas is independently established, and these formulas are immediately applicable to reentrant resonators and resonators containing inhomogeneous media. Author (TAB)

**N66-13536#** Institut Franco-Allemand de Recherches, St. Louis (France).
**SURVEY OF THE PRESENT SITUATION IN THE FIELD OF LASERS [UBERSICHT UBER DIE DERZEITIGE SITUATION AUF DEM LASERGEBIET]**
E. David 2 Oct. 1963 25 p In GERMAN
(ISL-T-21/63) CFSTI: HC $1.00/MF $0.50

A brief review on the state-of-the-art for optical lasers is given. Theoretical analyses of causes and effects of stimulated light emission are described, construction principles and materials evaluated, and the modulation and application of lasers is discussed. Transl. by G.G.

**N66-13744#** International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
**STUDIES ON HIGH POWER GaAs LASERS Final Technical Report, Jun. 1, 1963–May 31, 1965**
R. S. Title [1965] 60 p refs
(Contract Nonr-4136(00); Proj. Defender)
(AD-621649) CFSTI: HC $3.00/MF $0.75

The report is a report on the studies of factors influencing the high power operation of GaAs injection laser diodes. The report deals specifically with aspects of GaAs crystal preparation, electrical and optical characterization of the material, and with the design, parameterization, and testing of GaAs injection laser diodes. Diodes have been operated at 77K with an energy output in excess of 0.001 joules during a 120 micron sec. pulse and with an external quantum efficiency of 18%. TAB

**N66-13799#** Aeronutronic, Newport Beach, Calif.
**CHEMICALLY PUMPED LASER SYSTEM First Quarterly Progress Report, 25 Jun. 1964–31 Jul. 1965**
S. Byron, W. Kuby, W. Lawrence, and R. V. Finizie 31 Aug. 1965 27 p refs
(Contract DA-36-034-AMC-0325(T))
(U-3259; AD-622398) CFSTI: HC $2.00/MF $0.50

A summary is given of the state of the art in chemical pumping of lasers, the potential performance by various approaches is evaluated, and the specific approach chosen for further development under this contract is described. The program plan for the remainder of the contract is outlined and progress during the past quarter is described. During this quarter an experimental evaluation of various radiation coupling geometries and window materials led to a successful test in which laser action was produced in a ruby by shock heated xenon. A summary is also given of earlier studies by the Bio-Technology Department of the Philco C and E Division, Blue Bell, Pennsylvania, which were directed toward measuring eye damage in monkeys caused by laser irradiation. Author (TAB)

**N66-14034#** Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
**RESEARCH TOWARD A TUNABLE COHERENT LIGHT SOURCE Final Technical Report, 1 May 1964–30 Apr. 1965**
Norman I. Adams 30 Jul. 1965 162 p refs
(Contract Nonr-4572(00))
(Rept.-8071; AD-619530) CFSTI: HC $5.00/MF $1.00

The goal of the program is the development and demonstration of a tunable coherent light source based on nonlinear optical effects. An intermediate goal is the demonstration of parametric gain at optical frequencies. An apparatus was designed and constructed which is able to measure small gains or losses and which is named the 'Optical Marginal Oscillator.' The most recent version of the optical marginal oscillator is just about sensitive enough to measure the optical parametric effect expected in a specific experiment using two CW He-Ne lasers and crystal of ADP. A device, to produce a controlled loss of small magnitude was designed, built, and tested. The controlled loss may be made to be of the same size as the loss which is expected to be produced by the parametric effect in this experiment and has been used successfully to evaluate the marginal oscillator. Data were obtained on the performance of the optical marginal oscillator and on the dependence of its performance on the principal adjustable parameters, which are the oscillator light level and the modulation frequency. At the end of the current contract we are setting up the experiment to measure parametric gain. TAB

**N66-14177#** General Telephone and Electronics Labs., Inc., Bayside, N. Y.
**CHELATE LASERS Annual Summary Report, 1 Oct. 1964–30 Sep. 1965**
A. Lempicki, H. Samelson, and C. Brecher 30 Oct. 1965 52 p refs
(Contract Nonr-4134(00); ARPA Order 306-62; Proj. Defender)
(TR-65-052.11; AD-623264) CFSTI: HC $3.00/MF $0.50

The investigation of chelate lasers has as its objective the evaluation of the potentialities of liquid lasers and the analysis and improvement of their performance. Toward this end, the work was designed to proceed along two parallel and complementary lines: an investigation of the chemical properties of the materials, in terms of the requirements for laser action; and an investigation of the physical properties of the chelate laser itself, in terms of the design and improvement of the laser cavity and associated equipment. The report summarizes previous work and describes in detail the progress on these lines in the past year. A full-length paper entitled 'Spectroscopy and coordination chemistry of europium chelate solutions: concentration and solvent effects' is included as an appendix. TAB

**N66-14188#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
**DESIGN, CONSTRUCTION, AND STUDY OF A METAL TUBE Ar II LASER**
Edward D. Aitken and John W. Dettmer (M.S. Thesis) Aug. 1965 73 p refs
(GE/EE/65-1; AD-623139) CFSTI: HC $3.00/MF $0.75

To provide a better method of cooling an argon ion laser, the arc-tube was constructed by alternately stacking 52 copper discs (1/8 in. long with a 3/32 in. hole in the center) and 53 viton O-rings. For this design the optimum fill-pressure was experimentally determined to be 0.24 torr and the voltage gradient in the arc-tube was 6.8 volts/cm. Over the discharge current range of 7.5 to 17.5 amperes, the power output varied as I (3.5). By shorting groups of discs together, it was found that metal tube lasers can be constructed of segments with length-to-bore ratios of up to 11.33. Author (TAB)

**N66-14191#** Illinois State Water Survey, Urbana.
**EVALUATION OF THE MASER-EQUIPPED RADAR SET AN/MPS-34 AND AREA PRECIPITATION MEASUREMENT INDICATOR Quarterly Progress Report, 1 Apr.–30 Jun. 1965**
R. E. Rinehart and D. M. A. Jones [1965] 12 p
(Contract DA-28-043-AMC-01257(E))
(QPR-1; AD-623468) CFSTI: HC $1.00/MF $0.50

Problems encountered in the installation, operation, and repair of the MASER-equipped MPS-34 radar and Area Precipitation Measurement Indicator (APMI) are discussed. Both units are nearly ready for data collection. An outline is given for operations during the next quarter. Author (TAB)

**N66-14272#** Bell Telephone Labs., Inc., Murray Hill, N. J.
**SOLID-STATE MASER RESEARCH (OPTICAL) Quarterly Progress Report, 14 Feb.–14 May 1965**
J. E. Geusic 14 May 1965 19 p refs
(Contract DA-36-039-AMC-02333(E))
(QR-7; AD-619706) CFSTI: HC $1.00/MF $0.50

The report presents work on the YAIG:Nd laser oscillator which relates to fundamental oscillator theory. It is experimentally verified that the YAIG:Nd oscillator is correctly described as a saturated regenerative amplifier of noise. Also presented in the report are some preliminary study results of the amplitude fluctuations of the YAIG:Nd laser. Author (TAB)

**N66-14317#** Martin Co., Orlando, Fla.
**QUANTUM MULTIPLIERS AND MIXERS First Quarterly Progress Report, 1 May–31 Jul. 1965**
V. E. Derr, G. W. Bechtold, and R. A. Kempf Oct. 1965 51 p refs
(Contract DA-28-043)AMC-01320(E))
(Rept.-1; AD-623470) CFSTI: HC $2.00/MF $0.50

The theoretical basis for harmonic generation due to nonlinear quantum susceptibilities in gases is reviewed. Examples of partly resonant and resonant systems are given. The initial experimentation on the apparatus for a two-level, third harmonic, partly resonant system is discussed. Preparation for construction of apparatus for the resonant frequency scheme is described. Absorption studies of multiple quantum effects in MgO ($Mn^{2+}$) are discussed. Author (TAB)

# 17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

**N66-13391** Joint Publications Research Service, Washington, D. C.
**MEANS OF IMPROVING CORROSIVE RESISTANCE OF ALLOYS**
Chun-ming Ch'en *In its* Transl. on Communist China's Sci. and Technol. No. 247 26 Nov. 1965 p 54–75 refs Transl. into ENGLISH from K'o Hsueh T'ung-pao (Scientia), (Peiping), no. 9, 20 Sep. 1965 p 799–804 (See N66-13388 04-34) CFSTI: $3.00

The corrosion resistance of alloys is discussed and methods for improving corrosion resistance of alloys are summarized. It is concluded that since the corrosion process of a

metal is determined by many complicated factors it is not possible to predict the corrosive properties on the basis of the alloy composition. However, if the principles discussed are followed, the time required to trial produce corrosion resistant alloys will be greatly reduced. E.E.B.

**N66-13411#** United States Steel Corp., Monroeville, Pa. Applied Research Lab.

**EFFECT OF ROLLING RATIO ON THE ANISOTROPY OF 5Ni-Cr-Mo-V STEEL PLATES**

S. J. Manganello and L. F. Porter 1 Dec. 1964 27 p refs
(Contract NObs-88540)
(S-11402; AD-456358)

A study was initiated to evaluate the effect of rolling ratio (from straightaway rolling to 1 to 1 cross rolling) on the anisotropy of 1-inch-thick plates (rolled in the Laboratory from 7-1/4-inch-thick slabs) of the 5Ni-Cr-Mo-V experimental HY-130/150 steel and the effects of subsequent heat treatments on this anisotropy. The results showed that the tensile properties of the as-rolled plates were not significantly affected by the amount of cross rolling. At cross-rolling ratios of 4 to 1 and lower, the plates exhibited no significant anisotropy in the Charpy V-notch energy absorption at 0° F. However, at cross-rolling ratios of 8 to 1 and higher, the energy absorption in the strong direction was 40 to 58 ft-lb higher than that in the weak direction. The energy-absorption anisotropy of the as-rolled plates was reduced by the standard austenitizing, quenching, and tempering treatment, and it was further reduced by a double-austenitizing treatment. The results generally indicated that 5Ni-Cr-Mo-V steel plates should not exhibit any deleterious anisotropy if the rolling ratios are 4 to 1 or lower for single-austenitized plates or 8 to 1 or lower for double-austenitized plates. Author

**N66-13458#** California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

**EFFECT OF EXPOSURE TIME ON CAVITATION DAMAGE**

Milton S. Plesset and Robert E. Devine Aug. 1965 30 p refs
(Contract Nonr-220(28))
(Rept.-85-31; AD-471191)

It has been proposed in some recent publications that the cavitation damage rate decreases markedly in solids after long exposure to cavitation. It has also been proposed that this low rate of cavitation damage is the one with physical significance for the solid. These observations have been made with specimens oscillated sinusoidally in liquids by means of magnetostrictive devices. In the observations described here it is shown by means of photographs of the cavitation cloud over such specimens that the reduced damage rate results from the very sparse bubble cloud which is formed over the deeply damaged surface. The change in the damage rate therefore has hydrodynamic origin and is not related to a change in the properties of the solid. X-ray analyses show also that the extent of the plastic deformation of a solid with very light damage is the same as for a solid with very heavy damage. Author (TAB)

**N66-13509#** Michigan Univ., Ann Arbor.

**A COMPARISON BETWEEN MEASURED AND CALCULATED ACTIVITY COEFFICIENTS IN MULTICOMPONENT LEAD-BASE LIQUID ALLOYS CONTAINING CADMIUM**

Kazuhisa Okajima and Robert D. Pehlke 1963 11 p refs
(Contract AT(11-1)-1352)
(TID-21112) CFSTI: HC $1.00/MF $0.50

The activity of cadmium in multicomponent lead-base alloys was measured and compared with estimated activity coefficients using interaction parameters. The results of this study show that this technique is a useful and reasonably accurate means for estimating activity coefficients in dilute solutions. Since the equation on which the calculation was based is only rigorous at infinite dilution, and because the interaction parameters used in the calculation were of limited accuracy, a quantitative evaluation of this approach for this particular system was not possible. Author (NSA)

**N66-13552*#** Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.

**CREEP AT ELEVATED TEMPERATURES AND HIGH VACUUM Semiannual Report No. 3, May 1–Oct. 31, 1965**

K. Schroder, A. Giannuzzi, and G. Gorsha Nov. 1965 21 p refs
(Grant NsG-619)
(NASA-CR-68735; MET-E-1189-1165-SA) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The program has been expanded considerably since the second semi-annual report was submitted. A second vacuum system has been constructed, which enables us to achieve a better vacuum. Specimens can be exchanged more quickly, and the sample can be repeatedly loaded and unloaded at all temperatures. A titanium sublimation pump additional to the Vac-Ion pump has been incorporated into the system. The glass sections have been reduced and the glass parts are easily removable and replaceable. Thus, delays due to glass breakage have been markedly reduced. We achieved at room temperature pressures of $2 \times 10^{-10}$ mm Hg after a 2 hour outbaking at 180° C. The sample section has been heated to temperatures of 800° C. The heater should be powerful enough to obtain temperatures well above 1000° C in the test section. Length changes of the specimens are measured photographically using a 35 mm camera. These films are now analyzed on a microscope stage. This makes it possible to determine $\Delta L/L$ presently to about $1 \times 10^{-4}$. By using a fine grain film we should be able to increase the sensitivity to approximately $\Delta L/L \simeq 10^{-5}$. Results on creep tests on polycrystalline copper show that the strength of a specimen changes noticeably if tested with either an argon bombarded "clean" surface or a reoxidized surface. Author

**N66-13608#** General Electric Co., Cincinnati, Ohio. Atomic Products Div.

**HIGH TEMPERATURE MATERIALS PROGRAM Progress Report No. 51, Part A, Jun. 15–Aug. 15, 1965**

30 Sep. 1965 60 p refs
(Contract AT(40-1)-2847)
(GEMP-51A) CFSTI: $3.00

Research is reported in the following areas in a high temperature materials program: oxidation resistant fuel elements, reactor materials evaluations, thermocouple and electrical materials, and refractory metal alloys. Fuel element research consists of laboratory testing of Fe-Cr-Al-Y specimens, in-pile testing of clad Fe-$UO_2$ specimens, and weight gain data for a series of Fe-Cr-Al-Y alloys. Reactor materials evaluations include creep rupture tests of arc cast tungsten, molybdenum, and W-25Re-30Mo (at. %). The thermoelectric properties of Cr-20 Os and Mo-10Ru-10 Os were measured as a function of temperature, and Cr-20 Os was found to be a good negative thermoelement material. Also investigated in this area was the resistivity of BeO. Studies of refractory-metal alloys include the effects of rhenium content of less than 25 percent in the W-Re-Mo system, preparation of Mo-W-Re alloys with high molybdenum content, and fabrication of W-25Re-30Mo alloy as plate, sheet, and seamless tubing. C.T.C.

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**N66-13612#** National Bureau of Standards, Boulder, Colo. Cryogenics Div.

**SPARK PLANING DAMAGE IN COPPER**

John J. Gniewek, Alan F. Clark, and John C. Moulder 6 Sep. 1965 9 p refs

(NBS-TN-321) GPO: $0.15

The damage to copper crystals, produced by spark planing operations, has been measured using a dislocation etch pit technique. The tabulated results show the depth of damage to vary from 0.7 to 1.1 mm on the coarsest planing range used to 0.2–0.3 mm on the finest range. Two photomicrographs showing the etch pit density increase near the spark planed surface are included. Author

**N66-13654#** Babcock and Wilcox Co., Alliance, Ohio. Research Center.

**MATERIALS EXAMINATION OF A MODEL SODIUM HEATED STEAM GENERATOR**

E. Fortner and P. J. Kovach 27 Aug. 1965 45 p refs

(Contract AT(11-1)-1280)

(BAW-1280-31) CFSTI: HC $2.00/MF $0.50

The purpose of this test program is to assess the compatibility of Croloy 2-1/4 and TP 316 SS in a liquid sodium system, particularly with reference to the design parameters of a full-size sodium-heated steam generator. The samples were as-received commercial pipe and sections of pipe removed from the model steam generator after 1000, 2000, and 4000 hours of operation. The Croloy 2-1/4 was at 1000° F. TP 316 SS pipe was removed from two positions, one at 1000° F and the other at 1100° F. Metallographic and microhardness studies were made of each sample. As-received and 4000 hour samples of Croloy 2-1/4 and 316 SS (1100° F) were analyzed with the electron microprobe X-ray analyzer. Two special heat treatments were used with selected specimens to substantiate conclusions based on examination of the loop material. The as-received Croloy 2-1/4 was slightly decarburized and contained surface depletions of chromium and silicon. Nickel and copper were piled up near the surfaces. These initial gradients (attributed to oxidation during mill treatment) and tempering effects complicate assessment of mass transfer processes. Slight decarburization (detectable to about 15–20 mils after 4000 hours), copper depletion, and nickel pickup occurred during exposure. No preferential mass transfer was indicated by the examination of the TP 316 SS samples although a general attack is probable. The material is characterized by sensitization during exposure and by persistent banding. Author (NSA)

**N66-13659#** Oak Ridge National Lab., Tenn.

**STRAIN BEHAVIOR IN ZIRCALOY-2 SHEET-TYPE TENSILE SPECIMENS**

P. L. Rittenhouse and M. L. Picklesimer Sep. 1965 31 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1226) CFSTI: HC $2.00/MF $0.50

Rolling and transverse direction sheet-type tensile specimens of highly textured Zircaloy-2 were prepared and tested to study strain behavior as a function of specimen geometry. The results of these tests are compared with those obtained from round tensile specimens of the same material. Nonuniform strain is exhibited in the necked region of the sheet specimens. This adds to the difficulty of using this type of specimen as a measure of strain anisotropy through ratios of contractile to axial strain. Some peculiarities in necking behavior are also discussed. Author (NSA)

**N66-13663#** Atomic Weapons Research Establishment, Aldermaston (England).

**URANIUM CORROSION STUDIES. PART I: AN OPTICAL METHOD FOR FOLLOWING OXIDE FORMATION**

J. H. Grimes and J. R. Morris Aug. 1965 25 p refs

(AWRE-O-66/65) CFSTI: HC $1.00/MF $0.50

An apparatus was developed to measure the growth rates of oxide films on polished uranium surfaces in controlled atmospheres. The rate of oxidation of polished uranium surfaces in the presence of water vapor at 50° C and 70° C was determined, and the results are compared with those of other workers. Author (NSA)

**N66-13723#** Naval Research Lab., Washington, D. C.

**METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Seventh Quarterly Report**

R. J. Goode, D. G. Howe, R. W. Huber, P. P. Puzak, K. B. Lloyd et al May 1965 80 p refs

(NRL-6327; AD-621567) CFSTI: HC $3.00/MF $0.75

A progress report covering research studies in high strength structural materials is presented. Fracture toughness index diagrams are presented for titanium and aluminum that define the expected yield strength region of high fracture toughness, requiring plastic overloads for fracture propagation, and low fracture toughness, requiring elastic stresses for fracture propagation, and linear elastic fracture mechanics techniques for determining elastic stress level required for fracture. Results on heat treatment and alloy development studies are reported for several titanium alloys and drop-weight tear test results on some commercially produced aluminum alloys are described. Results of plane strain fracture toughness tests on unalloyed titanium using single-edge-notched and side-notched specimens are reported. Explosion bulge tests on a series of 5Ni-Cr-Mo-V and maraging steel weldments are described in which the results appear encouraging. Low cycle fatigue crack propagation studies on D6AC and 4335 high strength steels are described in which an acceleration of fatigue crack growth rate was seen for each steel in a salt water environment. The 4335 steel test results indicated a stress corrosion cracking condition operating in addition to the action of fatigue cracking. Author (TAB)

**N66-13732#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

**OXIDATION OF TUNGSTEN AND OTHER REFRACTORY METALS**

Apr. 1965 199 p refs Presented at the Joint AIME/AF Mater. Lab. Symp., New York, 31 Oct. 1962

(AFML-TR-64-162; AD-620877) CFSTI: HC $5.00/MF $1.25

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**N66-13733** Ohio State Univ., Columbus. Dept. of Metallurgy.
**METHODS FOR STUDYING HIGH TEMPERATURE OXIDATION REACTIONS**
Rudolph Speiser and G. R. St. Pierre *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 3–23 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25
(Contract AF 33(616)-8005)

Techniques used to determine the metal-oxygen equilibria, oxidation rates, defect structure of oxide formations, and volatile products of oxidation are discussed in a review of the high temperature oxidation reactions of the refractory metals Mo, Nb, Ta, and W. Discussions are included of the use of galvanic cells and the calorimetric method for obtaining thermodynamic data, and the determination of solubility limits by standard X-ray lattice parameter and metallographic methods. Gravimetric methods for determination of the homogeneity range in refractory metal oxides are considered, as is gas entrainment to produce equilibrium. Gravimetric method, volatilization, and diffusion are included among the experimental procedures employed in investigations of oxidation kinetics. M.W.R.

**N66-13734** Philco Corp., Blue Bell, Pa. Aeronutronic Div.
**HIGH PRESSURE OXIDATION OF REFRACTORY METALS—EXPERIMENTAL METHODS AND INTERPRETATION**
W. M. Fassel, Jr., J. N. Ong, and A. M. Saul Refractory Metals Apr. 1965 p 25–52 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25

An historical review is included along with a discussion of present-day experimental methods related to high pressure oxidation of refractory metals. Thermodynamic and kinetic aspects of the effect of pressure and the influence of reactor on oxidation experiments are reviewed. Expressions are given for the determination of pressure dependence on concentration and the effect of pressure on phase stability. Rate constant values are given for phase boundary and/or diffusion processes for Co, Nb, Ni, Ta, and W. M.W.R.

**N66-13735** Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
**INITIAL STAGES OF THE OXIDATION OF TUNGSTEN AND TANTALUM**
D. W. Rausch and K. L. Moazed *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 53–77 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25
(Contract DA-33-019-ORD-3387)

The surface product of the reaction of gaseous oxygen on Ta and W substrates is found to be critically dependent on substrate temperature, crystallography, and oxygen coverage. Nucleation of oxide is preceded by adsorption. The tungsten–oxygen reaction below 400° C and at oxygen pressures as high as $10^{-5}$ mm Hg is characterized by stable adsorbed states with no apparent tendency for oxide formation. At temperatures between 400° and 1000° C, the oxide is nucleated after the adsorption of at least a monolayer. Nucleation occurs on certain preferred regions at sites which are about 100 Å apart. Tantalum displays the same general characteristics. Under higher pressure conditions, oxide crystallites are randomly distributed over a surface exhibiting relatively low coverage. The apparent absence of preferential nucleation at a grain boundary is probably due to oxygen deficiency on the surface caused by diffusion into the grain boundary. The field electron emission microscope is found to be extremely well suited for studies of nucleation and growth in the initial stages of Ta and W oxidation. M.W.R.

**N66-13736** Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
**FOUR TYPES OF OXIDATION PROCESSES IN THE OXIDATION OF TUNGSTEN**
E. A. Gulbransen, K. F. Andrew, and F. A. Brassart *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 81–107 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25
(Contract AF 33(616)-7888)

Reactions of tungsten with oxygen as a function of temperature and pressure have produced four types of formations: (1) protective oxide film, (2) nonprotective oxide scale, (3) oxide scale with simultaneous vaporization of tungsten trioxide, and (4) tungsten trioxide gas without any appreciable oxide film film or scale. Effect of temperature on tungsten oxidation was studied for four pressures at temperatures between 1250° and 1615° C. Initial rate of weight loss values followed an exponential function of temperature; and a heat of activation of 14300 cal/mole was estimated. Effect of pressure was also studied. Following analyses, it was proposed that for temperatures above 1250° C and oxygen pressures above 5 Torr, the rate-limiting process is the transport of oxygen through a boundary layer of gaseous reaction products. High heat rates were associated with rapid oxidation of tungsten. M.W.R.

**N66-13737** Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
**THE REACTIONS OF GASEOUS SYSTEMS WITH TUNGSTEN AT ELEVATED TEMPERATURE**
George R. St. Pierre and Rudolph Speiser *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 109–124 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25

Experimental data is presented to demonstrate the processes of oxidation and vaporization of tungsten in the W-O-H and W-O-C systems. Tungsten–oxygen phase equilibria at low temperature are illustrated as are $CO_2$–CO ratios for stabilities of the tungsten oxides at higher temperatures. Tungsten specimens did not lose weight until a sufficiently high $CO_2$–CO ratio was achieved; at a critical ratio, the weight loss is quite large. It is possible, however, to stop the weight loss by reducing this ratio. Scale formation on tungsten is discussed, and vapor phase reactions are investigated. Although vapor loss rate is observed to vary linearly with water vapor pressure over the range of conditions studied, it is considered invalid to infer that a simple first order mechanism can account for this behavior. A rationale for the behavior is presented, but additional mechanistic studies are required to establish its validity. Also, the nature of the growth of oxide crystals on tungsten must be further resolved. M.W.R.

**N66-13738** Lockheed Missiles and Space Co., Sunnyvale, Calif. Materials Sciences Lab.
**OXIDATION OF TUNGSTEN AT ULTRA-HIGH TEMPERATURES**

Roger A. Perkins, William L. Price, and Donald D. Crooks *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 125–150 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25

Rate of oxidation of tungsten is a function of metal temperature, oxygen pressure, and crystal orientation. From 1300° to 3350° C, the rate in air or oxygen at pressures below 5 mm Hg is equal for the same partial pressure of oxygen. In static or slow-moving air at all pressures and in oxygen at pressures above 3.0 mm Hg, oxidation rates may be limited by transport of oxygen to the surface. When a constant oxygen pressure is maintained at the metal surface, gas velocity up to Mach 1 has no effect on the rate of reaction. A visible oxide scale does not form on tungsten in oxygen at low pressure at temperatures above a boundary defined by $P_{O_2} = 1.161 \times 10^{14} \exp(-93500/RT)$; in air the boundary is defined by total pressure. Rate of metal loss, transition in rate behavior, and maximum rate of oxidation are discussed. At temperatures above the rate maximum, the rate of metal loss increases as a linear function of oxygen pressure and decreases with temperature. A common mechanism appears to exist in the oxidation behavior of tungsten at high temperatures in oxygen at pressures from $10^{-8}$ to at least 10 mm Hg. M.W.R.

**N66-13739** Central Inst. for Industrial Research, Blindern (Norway).

**OXIDATION BEHAVIOR OF TANTALUM AND NIOBIUM AT HIGH TEMPERATURES**

Per Kofstad *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 151–171 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25

Oxidation behavior of niobium and tantalum are similar at temperatures below 1000° C, although there is a change in the reaction mechanism at 600° C for Nb and 800° C for Ta. Above these temperatures, the metallic oxide phases are no longer found at the metal–oxide interface. The initial oxidation, approximately parabolic, primarily involves pentoxide formation. This stage is followed by near-linear oxidation, which results from the breakdown of the protective properties of the pentoxide scale. Arrhenius plots of the linear oxidation rate constants show reversals in temperature dependence at one atm oxygen at about 600° and 700° C for Nb and Ta, respectively. There are no reversals at lower oxygen pressures. At higher temperatures and pressures above about 0.01 torr, oxygen dissolution is of minor importance compared to the total weight gain during oxidation, but dissolution occurs at a rapid rate. Research efforts must, therefore, be directed to the reduction of oxygen dissolution and rate oxygen diffusion in Nb and Ta. M.W.R.

**N66-13740** General Telephone and Electronics Labs., Inc., Bayside, N. Y.

**BASIC FACTORS IN THE DESIGN OF PROTECTIVE COATINGS FOR TUNGSTEN**

M. G. Nicholas, C. D. Dickinson, A. L. Pranatis (Calif. Univ. Lawrence Radiation Lab., Berkeley), and C. I. Whitman (Copper Prod. Develop. Assoc.) *In* AFSC Oxidation of Tungsten and Other Refractory Metals Apr. 1965 p 173–190 refs (See N66-13732 04-17) CFSTI: HC $5.00/MF $1.25

Since platinum-group metal and silicide coatings are of limited use at temperatures above 2000° C, consideration is given to the design of other protective coatings for tungsten. Hafnium and zirconium oxide systems are considered to have the most promise because of the refractoriness of their oxides, relative lack of proneness to breakaway, low rates of vaporization, resistance to hydration, and lack of toxicity and radioactivity. Preliminary research with such systems must determine if the oxides can be grown by diffusion-controlled processes and if breakaway can be delayed or circumvented. Requirements for high temperature coatings as well as potential of the platinum-group metal and silicide coatings are discussed. M.W.R.

**N66-13742#** Naval Research Lab., Washington, D. C.

**EXAMINATION OF ELECTRON BOMBARDMENT HEATING FOR EFFECTS ON THE TENSILE PROPERTIES OF TUNGSTEN**

H. Doering and P. Shahinian 21 Sep. 1965 9 p refs (NRL-6278; AD-622442) CFSTI: HC $1.00/MF $0.50

The effects of heating with 10-kv electron beams were studied by comparing the tensile properties of tungsten heated by electron bombardment and by thermal radiation. Bombarded specimens with both undisturbed and visibly damaged surfaces were tested at both room and high temperatures. At 2200° C the ultimate tensile strength obtained when heating by thermal radiation was found to be the same as the strength obtained when heating by electron bombardment. Also, prolonged bombardment heating at 2400° C under conditions not producing any surface changes prior to testing did not influence the tensile properties when compared to heating by thermal radiation. Normal strengths were reduced by bombardment only when surfaces were visibly damaged, the reduction being greatest at room temperature and considerably less at the higher temperature. The modes of fracture and the microstructure of failed specimens were independent of the means of heating. On the basis of these results it appears that electron bombardment heating, if properly applied, can be used in conducting valid mechanical property tests at high temperatures. Author (TAB)

**N66-13775#** MSA Research Corp., Callery, Pa.

**FACTORS AFFECTING THE COMPATIBILITY OF LIQUID CESIUM WITH CONTAINMENT METALS Second Quarterly Progress Report, May–Jul. 1965**

F. Tepper and J. Greer 26 Aug. 1965 13 p (Contract AF 33(615)-2386) (MSAR-65-111)

The mechanisms of attack of structural metals by cesium metal is being studied. A two phase natural convection loop has been fabricated. The ultrahigh vacuum test chamber to be used in operation of refractory metal loops has been received, modified and checked out. Mass transfer tests have been performed with iron and nickel. The mass transfer rate is being measured gravimetrically. Author

**N66-13857#** Pratt and Whitney Aircraft, Middletown, Conn. Advanced Nuclear Engineering Lab.

**APPLICATION OF INTERNAL FRICTION METHODS TO CORROSION STUDY IN COLUMBIUM ALLOYS**

G. F. Schenck 30 Jul. 1965 21 p refs Presented at the ASM Symp. on Anal. Uses of Internal Friction at the ASTM Ann. Meeting, Purdue Univ., Lafayette, Ind., 16 Jun. 1965 (Contract AT(30-1)-2789) (CNLM-6344)

Lithium corrodes niobium and niobium–zirconium alloys intergranularly and on the <110> crystallographic planes when these alloys are contaminated with oxygen. In certain heat treated conditions, however, niobium–zirconium alloys are not attacked by the alkali metal even though they contain relatively large concentrations of oxygen. The internal friction behavior of oxygenated Nb–1 Zr alloy was studied to determine the physical situation of oxygen in the alloy at various heat treatment conditions. From this investigtion it became apparent that lithium is only able to corrode the niobium metal or alloy if the oxygen is in interstitial solid solution. Heat

treatment of the Nb–1 Zr alloy at temperatures near 2200° F permits corrosion stabilization of the alloy with oxygen concentrations as great as 2:1 atom fraction of the zirconium. The corrosion stabilization is achieved by precipitation of the oxygen as zirconium dioxide. Author (NSA)

**N66-13859#** Pratt and Whitney Aircraft, Middletown, Conn. Advanced Nuclear Engineering Lab.
**CARBURIZATION OF Cb–1Zr ALLOY**
N. S. Bornstein, E. C. Hirakis, and L. A. Friedrich Aug. 1965 23 p refs
(Contract AT(30-1)-2789)
(TIM-927) CFSTI: HC $1.00/MF $0.50

Methods for producing carbide coatings on Nb–1Zr alloy were investigated in an effort to improve the anti-galling characteristics of the alloy. Three carburization techniques were developed based on reaction with one of the following materials: (1) a slurry coating of oil–graphite, (2) a methane–argon atmosphere, or (3) a lithium–carbon solution. The coating thickness could be varied within the range of 0.001 to 0.006 inch depending upon the choice of technique and process conditions. Encouraging results were obtained in limited performance tests of threaded assemblies and simulated bearings. Based upon the kinetic data obtained as a result of the slurry oil–graphite study, it was tentatively concluded that the mechanism controlling the rate of growth of the carbide layer is the same in all three processes. Analysis of the data provided values for the activation energy for NbC film growth (−72.7 ±3 kcal/mol) and for $Nb_2C$ film growth (−68.8 ±3 kcal/mol). Author (TAB)

**N66-13901#** Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.
**GOVERNING FACTORS IN THE FORMATION OF $Cr_3O$-TYPE STRUCTURES Final Report**
Roy C. Wilcox, Fred W. Bull, and John F. Eckel 30 Jun. 1965 30 p refs
(Contract AT(40-1)-2564)
(TID-22200) CFSTI: HC $2.00/MF $0.50

Results are presented of the six ternary systems investigated. All systems have been completed and the results analyzed. Complete ternary solid solubility was found in the V–Si–Sn and V–Rh–Si systems between the $Cr_3O$-structures. There is some evidence of solubility between $Nb_3Al$ and $Nb_3Sn$ in the Nb–Al–Sn system. However, no solubility was found in the Cr–Si–Sn, the Nb–Rh–Si, and the Cr–Rh–Si systems. These results were unexpected in the Cr–Rh–Si system because both $Cr_3Rh$ and $Cr_3Si$ exist. Author (NSA)

**N66-13908#** California Univ., Livermore. Lawrence Radiation Lab.
**THE INFLUENCE OF STRAIN RATE ON MECHANICAL PROPERTIES OF 6061-T6 ALUMINUM UNDER UNIAXIAL AND BIAXIAL STATES OF STRESS**
K. G. Hoge 5 Aug. 1965 32 p refs Presented at the 2d Intern. Congr. on Exptl. Mech., Soc. for Exptl. Stress Analysis, Washington
(Contract W-7405-ENG-48)
(UCRL-12264, Rev. 1; CONF-650912-2) CFSTI: HC $2.00/MF $0.50

A technique is presented for determining mechanical properties of materials under dynamic tensile loads. A Dynapak metalworking machine was modified into a test fixture capable of producing the required dynamic loads for uniaxial and certain biaxial tensile tests. Results from uniaxial dynamic tests on 6061-T6 aluminum alloy are presented and compared to "static" data obtained from a universal testing machine. The dependence of tensile strength on strain rate and the augmenting effect of temperature on this dependence can be seen. The results of biaxial tests are described in terms of a modified form of the distortion-energy failure theory. Author (NSA)

**N66-13911#** Oak Ridge National Lab., Tenn.
**LOW-TEMPERATURE DUCTILITY AND STRENGTH OF VAPOR-DEPOSITED TUNGSTEN**
A. C. Schaffhauser [1965] 5 p refs Presented at 1965 Winter Meeting of the Am. Nucl. Soc., Washington, 15–18 Nov. 1965
(Contract W-7405-ENG-26)
(ORNL-P-1506; CONF-651101-19) CFSTI: HC $1.00/MF $0.50

Data are presented on the effects of heat treatment on the ductility and yield strength of vapor-deposited and powder-metallurgy W. Annealing at 1000° to 1800° C is found to decrease greatly the ductile-to-brittle transition temperature of vapor-deposited W to values lower than these for powder-metallurgy W. As-received powder-metallurgy W is stronger than vapor-deposited W, but after annealing at 1800° C and above, the situation is reversed. NSA

**N66-13942#** Pratt and Whitney Aircraft, Middletown, Conn.
**REFRACTORY METAL PROTECTIVE COATINGS FOR LONG TERM APPLICATIONS**
L. A. Friedrich, N. S. Bornstein, and E. C. Hirakis Sep. 1965 65 p refs
(Contract AT(30-1)-2789)
(PWAC-499)

A slurry applied coating was developed for the protection of refractory metal alloys in oxidizing, elevated temperature environments. The coating system, designated PWK-5, is based on a columbium silicide barrier layer interposed between the base metal and a refractory aluminide, tin-containing envelope. The methods used in the application of the coating are readily adaptable to large structural configurations. Mean lifetimes, derived from a statistical analysis of oxidation data for the PWK-5 coated Cb-1 Zr alloy composite exposed in 650° C and 1100° C air, exceeded 6000 and 800 hours, respectively. The reaction kinetics of the composite with air temperatures from 538° C to 1204° C conformed to a parabolic rate process. Evaluation of the factors affecting the behavior of the composite in 1093° C air indicated that the penetration of tin through the silicide barrier layer was the principal factor limiting coating lifetime. Thus, the analytical data confirmed the "wear-out" mode of failure indicated by statistical analysis. Limited testing at 1427° C indicated that coatings designed with thicker silicide or alloyed silicide barrier layers may be capable of providing increased lifetimes. Author

**N66-13945#** Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
**IMPERFECTIONS IN METALS. II: CORROSION AND OXIDATION Quarterly Report No. 7, Apr. 1–Jun. 30, 1964**
Brussels, EURATOM, [1964] 18 p refs
(Contract EURATOM-082-62-7 RDB)
(EURAEC-1223; EUR-2063; R-2314) CFSTI: HC $1.00/MF $0.50

Oxide films formed on annealed titanium in air at atmospheric pressure for varying time intervals at 450 to 700° C, were investigated by transmission electron microscopy and diffraction. The oxide films were stripped off by dissolution of the substrate. The films consisted almost completely of the rutile modification of titanium dioxide. The general grain structure of the substrate metal was replicated by the oxide film. Preferential oxidation at the grain boundaries took place, resulting in a

considerable grain-boundary thickening. Besides a heterogeneous behavior of the oxidation due to the rate dependence on the crystallographic orientation of the metal grains, a substructure was also observed within some of the individual grains. This island structure presented crystallographic orientations. The islands consisted of polycrystalline rutile whose appearance was strongly dependent on the time-temperature conditions for the oxidation. Pustules were also found but it is supposed that they do not represent an essential feature of the oxidation mechanism. Author (NSA)

**N66-13950#** Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

**ELECTRON MICROSCOPE STUDIES OF SECOND PHASE PARTICLES IN DILUTE ALLOYS OF URANIUM**

B. Mastel, T. K. Bierlein, and C. L. Corey 3 Mar. 1965 11 p refs (Contract AT(45-1)-1830)
(BNWL-SA-90)

Transmission electron microscopy was utilized to study particle size density distributions in dilute alloys of uranium. The results of a quantitative metallographic procedure used for determining particle size-density distributions from transmission electron micrographs agree well with that derived from replica electron micrography. The increase in resolution inherent in transmission techniques permits inclusion of particles normally too small to be resolved by replica methods. C.T.C.

**N66-13965#** Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.

**MICROSTRAIN PROPERTIES OF BODY CENTERED CUBIC METALS. TEMPERATURE AND STRAIN DEPENDENCE OF MICROYIELD POINTS IN COMMERCIALLY PURE TANTALUM Year End Report, 1964**

R. Kossowsky Mar. 1965 64 p refs
(WAD-S-149)

The dependence of the elastic limit and the anelastic limit of tantalum on prestrain, strain rate, and temperature was investigated using a capacitance extensometer and load-unload technique. An annealed specimen did not exhibit an elastic limit upon the first test where the elastic and anelastic limit actually coincide. After dropping from its initial value, the elastic limit was independent on further prestrain up to 6% but increased with decreasing temperature from 7500 psi at 298° K to 15 000 psi at 77° K. Also, the elastic limit was found to be independent of strain rate between $2 \times 10^{-4}$/sec to $2 \times 10^{-2}$/sec. The anelastic limit was independent of prestrain up to about $5 \times 10^{-3}$ which marks the end of the Lunders band region at room temperature. Strain rate cycling tests have shown that the anelastic limit was independent of strain rate. Rate of work hardening in the microstrain region increased with increasing strain rate and decreasing temperature. E.E.B.

**N66-14000#** Argonne National Lab., Ill.

**PHASE STUDIES ON U-20w/oPu-Fs ALLOYS Final Report**

Owen L. Kruger May 1965 37 p refs
(Contract W-31-109-ENG-38)
(ANL-6974) CFSTI: $2.00

The phase transformations, microstructures, and melting points of alloys containing U-20w/oPu-Fs were investigated as part of a broad program to evaluate plutonium-containing fuel materials of interest for the second loading of Experimental Breeder Reactor-II. The term fissium denotes the elements Ru, Mo, Pd, Te, Rh, Zr, and Nb in the proportions that are left in the fuel after pyrometallurgical refining. Crystallographic data are presented for the alpha and gamma uranium phases and other intermediate phases that occur in these alloys. A primary phase termed theta was present in all the alloys to their melting points. Transformations of the matrix phases appear to be somewhat similar to those in the U-Pu-Mo system. The gamma uranium phase was stable down to 555° C, and at high fissium contents, the beta transformation was entirely suppressed. Author

**N66-14008#** Naval Radiological Defense Lab., San Francisco, Calif.

**DETERMINATION OF THE TOTAL TRITIUM ACTIVITY ADSORBED ON THE SURFACE OF VARIOUS METALS**

William R. Balkwell and Don A. Kubose 19 Aug. 1965 15 p refs (USNRDL-TR-890; AD-622019) CFSTI: HC $1.00/MF $0.50

The total tritium activity adsorbed on structural steel, galvanized steel, brass and aluminum was found to be less than 10 micro-c of tritium/sq cm of surface for exposure concentrations of 0.23 mc of tritium/cu cm in air and an exposure time of one hour. Total tritium activity adsorbed on a carbon steel surface is much greater than for the other surfaces. An increase in the total tritium activity adsorbed with increasing tritium exposure concentration was observed for all the metals studied. The nature of this increase, assuming a clean surface, appears to depend on the surface texture of the material. At a constant exposure concentration (0.11 mc of tritium/cu cm) no significant change in the total tritium activity adsorbed was observed for exposure times from 15 min to 4 hr. Author (TAB)

**N66-14015#** Stanford Univ., Calif. Dept. of Materials Science.

**DISPERSION SOFTENED ZINC ALLOYS Tenth Technical Report**

W. H. McCarthy, J. C. Shyne, and O. D. Sherby 1 Sep. 1965 7 p refs
(Contract Nonr-225(60))
(DMS-65-35; AD-621749) CFSTI: HC $1.00/MF $0.50

Room temperature tensile tests were performed on zinc alloys containing submicron particles of ZnO, $\alpha$ $Al_2O_3$, carbon black and tungsten. Dispersion softening and substantial improvements in ductility as compared to pure zinc were observed when spheroidal particles were used. Strain softening was also encountered. The results are briefly explained on the basis of the fine and duplex slip which was observed in the composites. Stress field heterogeneity and thermal expansion effects were also considered. Author (TAB)

**N66-14035#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CONCERNING THE FORMATION OF SCALE WITH STRUCTURE $6ZrO_2$-$Nb_2O_5$ ON ALLOYS OF ZIRCONIUM WITH NIOBIUM**

Yu. F. Bychkov, V. A. Ivanov, and A. N. Rozanov 8 Jul. 1965 15 p refs Transl. into ENGLISH from Mosk. Fiz. Inst. Met. i Metalloved. Chistykh Metallov (USSR), no. 4, 1963 p 47–57 (FTD-MT-64-504; AD-619472) CFSTI: HC $1.00/MF $0.50

It is shown that during oxidation of alloys Zr-25% Nb and Zr-15% Nb-10% Mo in air on their surface along with $ZrO_2$ compound $6ZrO_2$-$Nb_2O_5$ will be formed, quantity of which during fairly strong oxidation at 1200C of alloy Zr-25% Nb reaches almost 100% and is close to 100% for the second alloy. Preliminary oxidation of these alloys at a temperature of 1200C at lowered pressure in oxygen and in air up to the formation of black oxide film somewhat increases their resistance to oxidation at 700C, which is not connected, however, with formation of oxide $6ZrO_2$-$Nb_2O_5$. Increased stability to oxidation of alloy Zr-25% Nb at temperatures below 600C, apparently

cannot be explained only by the formation of compound $6ZrO_2$-$Nb_2O_5$, inasmuch as even after oxidation at 600C the content of this compound in oxide film is small. Author (TAB)

**N66-14039#** United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

**THE EQUILIBRIUM OXYGEN PRESSURE OVER STAINLESS STEELS AND ITS RELATION TO REACTOR FUEL STABILITY**

E. J. Mc Iver and S. S. Teale London, HMSO, 1965 30 p refs (AERE-R-4942) HMSO: 4s 6d

The equilibrium oxygen pressure over mild and stainless steels have been measured using a galvanic cell technique. The oxygen pressure measured is considerably lower than that resulting from an iron oxide layer on pure iron. In the case of mild steel this is due to the carbon reducing the oxide layer, and in the case of stainless steels to chromium concentrating in the oxide layer. Data are also presented on the oxygen pressures over Fe/FeO, Mo/$MoO_2$, Cr/$Cr_2O_3$ and $MoO_{2.9}$. Author

**N66-14041#** Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

**SINTERING OF $(U,Pu)O_2$ PELLETS [FABRICATION DE PASTILLES D'OXYDES MIXTES D'URANIUM ET DE PLUTONIUM]**

G. Dean, C. Pelou, and D. Baugnies 1965 40 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-006-62-1 RAAF)

(CEA-R-2737; EUR-2222.f) CFSTI: HC $2.00/MF $0.50

In this paper, results of sintering of $UO_2$-$PuO_2$ solid solutions are presented. Two processes are described: the first one is the standard process involving mechanically mixed oxides $PuO_2$ and sinterable $UO_2$, whereas in the second one direct mixtures of $UO_3$ or $U_3O_8$ and $PuO_2$ are pressed and sintered. For the two processes, sintering is carried out in flowing pure or dilute hydrogen at a temperature of 1650° C during four hours. In both cases, the $(U,Pu)O_2$ pellets have the same general characteristics ($PuO_2 \simeq 20\%$): a bulk density between 96 and 99% of the theoretical density. Author

**N66-14064*#** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

**DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Eighth Quarterly Report, Mar. 21–Jun. 20, 1965**

G. G. Lessmann and D. R. Stoner [1965] 91 p refs

(Contract NAS3-2540)

(NASA-CR-54723; WANL-PR(P)-008) CFSTI: HC $3.00/MF $0.75 CSCL 11F

A study to determine the causes and effects of weld porosity in refractory metal alloys was completed. Porosity appeared to result from the degassing during welding of a pickling residue from the surfaces of the joint interface. Considerable variation in porosity sensitivity was observed between alloys. Overall alloy fabricability and porosity sensitivity appeared to be closely related. The most fabricable alloys can be welded using sheared edges, whereas the less fabricable alloys required machined edges and vacuum degassing following pickling. The three alloys included in the study of the effect of oxygen contamination on weldability were doped to the first test level and evaluated. R.W.H.

**N66-14066*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**DISTRIBUTION OF FAILURE TIMES IN STRESS CORROSION TESTS**

J. B. Gayle 1 Nov. 1965 16 p refs

(NASA-TM-X-53355) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The results of stress corrosion tests on aluminum alloys have been analyzed with respect to the statistical nature of the distribution of failure times. The analyses indicated that the data were represented adequately by a three-parameter Weibull distribution in which the induction period amounted to 85 percent of the time of the first observed failure and 55 percent of the time required for failure of half the specimens. Author

**N66-14132*#** TRW, Inc., Cleveland, Ohio. Materials and Processes Dept.

**DEVELOPMENT OF HIGH TEMPERATURE NICKEL-BASE ALLOYS FOR JET ENGINE TURBINE BUCKET APPLICATIONS Semiannual Report No. 1, 1 Apr.–1 Oct. 1965**

S. T. Scheirer and R. J. Quigg 20 Oct. 1965 121 p refs

(Contract NAS3-7267)

(NASA-CR-54504; ER-6666) CFSTI: HC $4.00/MF $1.00 CSCL 11F

A program was initiated to develop a material with superior properties at elevated temperatures for utilization in turbine blade applications. It is proposed that the necessary high temperature strength can be provided in a nickel-base superalloy by utilizing the maximum capability of the three available strengthening mechanisms, intermetallic gamma prime precipitation ($Ni_3Al$), solid solution strengthening with refractory and precious metals, and stable carbide formations through the addition of strong carbide forming elements. Through the addition of varying amounts of refractory metals (Mo, W, and Ta) it has been possible to statistically analyze the effects of each in a basic superalloy composition containing fixed amounts of Co, Cr, C, B, Zr, and Ni at three separate levels of Al and Ti. Tantalum was found to be more beneficial to 2000°F stress rupture properties than Mo or W, with tungsten the second most effective. The best alloys developed thus far in this program compare favorably with the best commercially available alloys and possess reasonable ductility. The base alloy composition selected for further study contained 8.0%Ta, 5.5%W, and 2.0%Mo. The titanium level has been fixed at 1.0 percent, while the aluminum will be varied on a statistical basis between 4.5 percent and 6.3 percent. Author

**N66-14169#** Battelle Memorial Inst., Geneva (Switzerland).

**ON THE THEORY OF NOTCH-BRITTLENESS IN STEELS OCCURRING DURING TIME-TO-RUPTURE TESTS**

W. Siegfried Brussels, EURATOM, Aug. 1965 81 p refs Presented at the Natl. Meeting of ASME, Berkeley, Calif., 9–11 Jun. 1965

(Contract EURATOM-100-62-12 RDS)

(EURAEC-1350; EUR-2325.e) CFSTI: HC $3.00/MF $0.75

The present experimental results are not sufficient to allow to give an exhaustive explanation of the embrittlement mechanism. The difference between the time-to-rupture curves for unnotched and notched bars can primarily be explained by the interaction of three effects: (1) relaxation of the stress peak with time, (2) formation and propagation of fissures in the material, and (3) inhibition of plastic deformation owing to the formation of a tridimensional state of stress. Author

**N66-14170#** Atomic Weapons Research Establishment, Aldermaston (England).

**THE CORROSION AND IGNITION BEHAVIOUR OF SOME URANIUM/PLUTONIUM/IRON ALLOYS. PART 2: ALLOYS CONTAINING MORE THAN 8 a/o IRON**

G. Picton and J. F. Sackman May 1965 16 p refs
(AWRE-O-18/65) HMSO: 3s 3d

Alloys containing 16.2 and 16.8 a/o iron have been compared with an alloy containing 7.7 a/o iron. There was no improvement in either the corrosion or the ignition behavior. Under accelerated corrosion conditions the 16.2 a/o iron alloy can corrode more rapidly at ~0% r.h. than at 95% r.h. because of cracking and disintegration. It is concluded that casting conditions are the most important parameters for good corrosion and ignition behavior. Author

**N66-14182#** General Electric Co., Schenectady, N. Y. Research Lab.
**RESEARCH TO INVESTIGATE THE MICROSTRUCTURE OF THE INTERNAL MAGNETIC FIELD IN SELECTED MAGNETIC MATERIALS Final Report, 10 Feb. 1964–10 Aug. 1965**
C. D. Graham, Jr., J. J. Becker, and I. S. Jacobs Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1965 73 p refs *Its* Rept.-65-GC-0316M
(Contract AF 33(615)-1490)
(AFML-TR-65-253; AD-623530) CFSTI: HC $3.00/MF $0.75

The magnetization of a gadolinium single crystal has been measured over a range of fields and temperatures. Magnetic measurements were made on $Fe_{2-x}Ge$ and $Fe_2B$. A relatively simple vibrating-sample magnetometer has been constructed for use in this program. A variety of experimental and theoretical work has been carried out on selected antiferromagnetic compounds. The low-temperature parallel susceptibilities of $FeF_2$ and $Cr_2O_3$ have been accounted for by the single-ion Van Vleck susceptibility mechanism, thus obviating the need for explanations based on canted spin structures or crystal imperfections. The compounds EuTe and $CoCl_2$ have been shown to have nonlinear transverse susceptibilities, and this effect has been shown to arise primarily from the field-dependence of the zero-point spin wave contribution to the free energy. Careful measurements of the magnetization of metamagnetic $FeCl_2$ have been made. Hysteresis has been observed in the metamagnetic transitions of $FeCl_2$ and $FeBr_2$, and analysis of this problem leads to the conclusion that hysteretic behavior should be expected in all transitions of this type at least under ideal conditions. The high-field measurements on $CoCl_2$ showed an anomalously high saturation moment per $Co^{2+}$ ion, and this has been explained by an exchange-enhanced g-shift. TAB

**N66-14195#** Bureau of Reclamation, Denver, Colo. Research Div.
**RELATIONS OF TENSILE STRENGTH AND HARDNESS OF STEEL**
William A. Pennington 14 Sep. 1965 17 p
(ChE-45; AD-623098) CFSTI: HC $1.00/MF $0.50

Data relating Brinell Hardness Number to tensile strength of plain carbon and low-alloy steel (under 5 percent alloy) taken from ASM Handbook, Volume 2, 8th Edition, p 670 (1964), have been used to develop three rather exact mathematical equations giving the hardness as a function of tensile strength. These equations have been employed to set up tabular data where the increment in the independent variable is constant thus leading to simpler and more reliable interpolations. It is anticipated that the data can be used for wrought steel products from tensile strengths of 50,000 psi up to about 265,000 psi for reinforcing bars for prestressed concrete. Author (TAB)

**N66-14209#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**METAL DIFFUSION IN PYROLYTIC GRAPHITE**
Martin Lewis Hammond (Ph.D. Thesis—Stanford Univ.) Jun. 1965 208 p refs
(LMSC-6-75-65-27; AD-622874) CFSTI: HC $6.00/MF $1.25

The diffusion coefficients of Nb-95 in PG were measured between 1450 and 1950C in three different types of PG which were chosen to represent substrate nucleated, combination substrate and regeneratively nucleated, and regeneratively nucleated microstructures. The diffusion coefficients parallel and perpendicular to the deposition surface were determined in as-deposited and partially graphitized PG. Autoradiography was used to observe the distribution of diffusing atoms. The structure of the PG was characterized by the application of many techniques of metallography, X-ray diffraction, small angle scattering of X-rays, and density determinations. A mathematical analysis of diffusion in layered structures was made and correlations between the structure and diffusion parameters noted. The activation energies for Nb diffusion in PG depended only upon direction and were independent of microstructure and state of graphitization. The activation energy for Nb diffusion parallel to the deposition plane was 96.2 kcal/mole and that perpendicular to it was 73.1 kcal/mole. The preexponential factors for a given direction differed only slightly for the various PG's used in this study; these factors were altered by the graphitizing heat-treatment. Author (TAB)

**N66-14232#** Naval Research Lab., Washington, D. C. Metallurgy Div.
**MARINE CORROSION STUDIES: STRESS-CORROSION CRACKING, DEEP OCEAN TECHNOLOGY, CATHODIC PROTECTION, AND CORROSION FATIGUE Third Interim Report of Progress**
B. F. Brown, B. W. Forgeson, T. J. Lennox, Jr., T. C. Lupton, R. L. Newbegin et al Jul. 1965 97 p refs
(NRL-Memo-1634; AD-621743) CFSTI: HC $3.00/MF $0.75

Contents: stress-corrosion cracking of titanium alloys in salt water, fresh water, and sea water; stress-corrosion cracking tests on welded titanium alloy plates; a new stress-corrosion cracking test procedure for high strength alloys; a study of the stress factor in corrosion cracking by use of the pre-cracked cantilever beam specimen; a study of the crystallographic orientation of cleavage facets produced by stress-corrosion cracking of Ti-7Al-2Cb-1Ta in distilled water; the effectiveness of sodium chromate to inhibit stress-corrosion crack propagation in aisi 4340 steel; metallic corrosion and cathodic protection to 5652 foot ocean depths; performance of tributyl tin oxide and cuprous oxide antifouling paints on 5086-H32 and 6061-T6 aluminum alloys in sea water and river water exposures; status report on the current distribution along a wire rope cathode; inoperative galvanic anodes related to improper chemical composition of the zinc; determination of the effective driving potential and effective d.c. resistance of galvanic anodes; low cycle fatigue crack propagation in 'wet environments'. TAB

**N66-14238*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ROOM-TEMPERATURE TENSILE BEHAVIOR OF (100) ORIENTED TUNGSTEN SINGLE CRYSTALS WITH RHENIUM IN DILUTE SOLID SOLUTION**
M. Garfinkle Washington, NASA, Jan. 1966 17 p refs
(NASA-TN-D-3190) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Tungsten single crystals oriented in the (100) direction with rhenium contents from 0 to 9 atomic percent were deformed in tension at room temperature. The addition of rhenium drastically affected the tensile behavior of these crystals. Rhenium additions increased the proportional limit stress and decreased both the flow stress and the rate of work hardening. In addition, discontinuous yielding and necking during deformation were observed in crystals containing 5 atomic percent or

more rhenium. Necking was not observed in unalloyed (100) oriented crystals. While deformation in the unalloyed (100) oriented crystals apparently involved both (110) and (112) slip, crystals with rhenium contents of 5 atomic percent or more deformed primarily by (112) slip. Traces attributable to (110) slip were found only in the work-hardened necked region of the 9 atomic percent rhenium crystals. The tensile behavior of these rhenium-containing crystals was similar to that of (110) oriented unalloyed tungsten crystals. Author

**N66-14239*#** Ilikon Corp., Natick, Mass.
**BASIC STUDIES ON DISPERSION HARDENING**
Robert Grierson and L. J. Bonis Washington, NASA, Jan. 1966 60 p refs
(Contract NASw-726)
(NASA-CR-360) CFSTI: HC $3.00/MF $0.50 CSCL 11D

To determine the qualitative and quantitative nature of the substructure and elastic strains retained in cold worked and annealed dispersion strengthened alloys, two observational techniques were used: transmission electron microscopy, and the Fourier analysis of X-ray diffraction line profiles. Transmission electron microscopy observations showed that partial annealing out of the dislocation structure introduced by cold work occurs at temperatures as low as 700° C, and that it is completely removed on annealing at 1100° C and above. Although X-ray observations did not detect any substructure in annealed specimens, it did show that a high level of elastic strain is retained in cold worked dispersion strengthened alloys. It was concluded that the increased strength observed in these alloys is due to the inability of the annealing treatment to relieve all elastic strains introduced into the matrix by the cold working. M.G.J.

**N66-14250#** Bureau of Mines, Reno, Nev. Metallurgy Research Center.
**CORRELATION OF YIELD BEHAVIOR IN ELECTROREFINED VANADIUM WITH INTERSTITIAL IMPURITIES**
Edward A. Loria, G. H. Keith, and E. A. Rowe 1965 36 p refs
(BM-RI-6716)

The Bureau of Mines analyzed the effects of oxygen, nitrogen, and carbon on the tensile properties of electrorefined vanadium in terms of the Petch equation. The effects of the different impurities and grain sizes on the yield and flow stress between 273° and 77° K were studied. Nitrogen was more effective than oxygen in increasing $\sigma_i$, the increase being about twice as much for the same impurity level. Carbon produced a slight increase in $\sigma_i$ up to 0.024 percent and then a gradual decrease in $\sigma_i$ to 0.11 percent, the maximum carbon content studied. The corresponding $k_y$ values followed the same trend in regard to oxygen and nitrogen additions, whereas the addition of carbon produced no variations at either temperature. Dislocations in vanadium are anchored by carbon, oxygen, and nitrogen with increasing firmness in that order. The high purity of electrorefined vanadium was confirmed by low yield stress and high ductility throughout the low temperature range. The metal also exhibited profuse twinning with high ductility at 123° and 77° K. The effective surface energy for fracture, $\gamma$, was found to lie between 3.3 and 3.6 $\times 10^4$ erg $cm^{-2}$. Author

**N66-14310#** IIT Research Inst., Chicago, Ill. Dept. of Metallurgical Engineering.
**GRAIN BOUNDARY MIGRATION** Technical Report No. 1
Paul Gordon Oct. 1965 46 p refs
(Grant DA-ARO(D)-31-124-G597)
(AROD-5030-1; AD-623594) CFSTI: HC $2.00/MF $0.50

Main results of boundary migration studies in polycrystalline materials are delineated. The effect of orientation and boundary structure factors and their interdependence with impurity effects are considered. Investigations aimed at the quantitative understanding of the drastic effect dissolved impurities have on boundary migration are examined. Results of these investigations are compared with the predictions of migration rate theories designed to account quantitatively for the impurity effect. Author (TAB)

# 18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

**N66-13330*#** Case Inst. of Tech., Cleveland, Ohio.
**MORPHOLOGY OF CRYSTALLINE POLYETHYLENE TEREPHTHALATE (PET) Semiannual Progress Report, May 1–Oct. 31, 1965**
J. L. Koenig [1965] 27 p refs
(Grant NGR-36-003-054)
(NASA-CR-68610) CFSTI: HC $2.00/MF $0.50 CSCL 20B

Various forms of crystallization of PET, both from supercooling and from orientation, have been studied. The purpose of this work is to characterize in detail the morphology and structure of the various types of crystalline units in PET. These results are being utilized in other studies being carried out; including IR studies of the chain conformation and folding of PET, mechanical behavior of PET under well-controlled conditions, etc. This report summarizes the preliminary investigation of PET. Much work is needed in the clarification of the various observations reported here. Author

**N66-13344** Library of Congress, Washington, D. C. Aerospace Technology Div.
**THE SEARCH FOR HEAT-RESISTANT POLYMERS**
Boris Nartsissov *In its* Foreign Sci. Bull., Vol. 1, No. 10 Oct. 1965 p 18–29 refs (See N66-13340 04-34)

Soviet interest in some special classes of heat-resistant polymers is further confirmed by several papers published in 1965. Research seems to be continuing along previously reported lines of study, namely in the field of the introduction of heteroatoms such as P, Ti, and N (in a heterocyclic ring) into the silicone backbone or in side groups. The study of such network structured polymers continues. At the same time, attention is also being focused on polybenzimidazoles and polyoxazoles. In this area the point of interest is the heat resistance and electrical properties of polybenzimidazole thin films, and an increase in the solubility of polyoxazoles. In addition, the thermal stability of polyconjugated polymers, such as polyphenylenes and polyacetylenes, is being studied. Author

**N66-13348** Library of Congress, Washington, D. C. Aerospace Technology Div.
**RESEARCH IN THE FIELD OF ORIENTED GLASS-REINFORCED PLASTICS (USSR)**
*In its* Foreign Sci. Bull., Vol. 1, No. 10 Oct. 1965 p 41–44 (See N66-13340 04-34)

An annotated listing of selected papers presented at the Soviet Conference on Oriented Glass-Reinforced Plastics, 6–10 April 1965, is given. R.C.M.

**N66-13433#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**INFLUENCE OF TEMPERATURE ON THE MECHANICAL PROPERTIES OF VITREO-PLASTICS**

V. S. Gumeniuk, A. A. Kritsuk, and V. I. Lositskii [1965] 5 p Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 1, no. 6, 1965 p 92–96

The mechanical properties of vitreo-plastics were investigated at normal and elevated temperatures. Samples were tested for compression, tension, and impact bending in the 233° to 423° K temperature range. It is shown that at elevated temperatures the yield point of a vitreo-plastic under tension is negligibly reduced. High temperatures exert a great influence on the strength of vitreo-plastics under compression. R.N.A.

**N66-13554*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**TENSILE AND STRUCTURAL PROPERTIES OF GLASSY CARBON**

W. V. Kotlensky and D. B. Fischbach 15 Nov. 1965 17 p refs (Contract NAS7-100)

(NASA-CR-68788; JPL-TR-32-842) CFSTI: HC $1.00/MF $0.50 CSCL 11B

Tensile properties of two different grades of glassy carbon have been measured from room temperature to 2900° C. Tests were made in a helium atmosphere, and heating was accomplished by means of an external graphite heater. Tensile strengths at room temperature for both grades were approximately 6000 psi. Both grades showed an increase in strength with increasing test temperature, reaching a maximum within the 20 000 to 25 000 psi range at 2500° C. Differences in the deformation of the two grades were evident from their ductility. Density, unit cell dimension, hardness, and diamagnetic susceptibility measurements were used to investigate the structural changes accompanying deformation and heat treatment. Electron micrographs revealed a difference in fracture mode. The tensile and structural behavior of glassy carbon has been compared with that of conventional carbon-base materials. It is suggested that cross-link bonding is responsible for the high strength of glassy carbon; however, the small crystallite size and the small pore size may also be contributing factors. Author

**N66-13572*#** IIT Research Inst., Chicago, Ill.

**DEVELOPMENT OF LIGHTWEIGHT THERMAL INSULATION MATERIALS FOR RIGID HEAT SHIELDS Summary Report No. 1, Jun. 25, 1964–Jun. 25, 1965**

A. J. Mountvala, H. H. Nakamura, and H. L. Rechter 25 Jun. 1965 146 p refs

(Contract NAS8-11333)

(NASA-CR-68709; IITRI-G6002-12) CFSTI: HC $4.00/MF $1.00 CSCL 11B

Exposed structural members at the base of large, high-thrust rocket engines are subject to excessive heating, largely radiative, from the engine exhaust. Castable, lightweight, insulating ceramic foams of zircon, mullite, and calcium aluminate have been prepared and evaluated for use as rigid heat shields in launch vehicles. The effects of various additives, including fibers and other opacifying materials to zircon foams, have been investigated. Chemically bonded, castable-type zircon foams have been optimized to meet certain specific requirements. These foams of 1/2 in. thickness show good insulative and mechanical characteristics when subjected to a heat flux of 40 Btu/ft$^2$-sec with simultaneous vibration of 60 cps, 1/2 in. double amplitude displacement and 90 g's acceleration. Property measurements on an optimized zircon foam disclosed very high optical reflectance in the near-infrared wavelength region and an extremely low thermal conductivity to 2300° F. A survey of commercially available material is also included. Author

**N66-13581#** Texas Univ., Austin. Lab. of Millimeter Wave Propagation and Astronomy.

**MILLIMETER RADOME ELECTRICAL DESIGN TECHNIQUES Semiannual Engineering Report, 1 Apr.–30 Sep. 1965**

Donald L. Purinton [1965] 26 p ref

(Contract AF 33(615)-2123)

(Rept.-1; AD-623581) CFSTI: HC $2.00/MF $0.50

Progress of an investigation to develop techniques for the design of electromagnetic windows having electrical and structural integrity in the frequency range from 40 Gc to 150 Gc is reported. Author

**N66-13636*#** Stanford Univ., Calif. Dept. of Materials Science.

**MECHANICAL BEHAVIOR OF POLYCRYSTALLINE NONMETALLICS AT ELEVATED TEMPERATURE Progress Report, Apr. 1–Sep. 30, 1965**

Oleg D. Sherby and Peter Burke [1965] 14 p refs

(Grant NGR-05-020-084)

(NASA-CR-68583) CFSTI: HC $1.00/MF $0.50 CSCL 11B

The creep behavior of polycrystalline aluminum oxide and sodium chloride is reviewed. Aluminum oxide, which has few slip systems and little ductility even at high temperatures, exhibits covalent bonding. Sodium chloride, which has several slip systems operating at high temperatures that result in considerable ductility, exhibits ionic bonding. The design and construction of a creep machine for testing cylindrical samples of aluminum oxide in compression at constant stress in controlled atmospheres up to 1700° C is essentially complete, including a constant stress lever arm and a high sensitivity extensometer. Further, equipment for compressive creep testing of sodium chloride in air or in an inert atmosphere is available and operative. It is pointed out that single crystal samples of sodium chloride are being grown, and an extrusion press was made so that dense polycrystalline samples can be made by extruding single crystals. R.R.D.

**N66-13729#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**HIGH MOLECULAR COMPOUNDS Selected Articles**

17 Sep. 1965 15 p refs Transl. into ENGLISH from Vysokomol. Soyedineniya (USSR), v. 6, no. 8, 1964 p 1407–1410, 1539 (FTD-TT-65-776/1+2+4; AD-622362) CFSTI: HC $1.00/MF $0.50

Contents: Nature of destruction of spherulitic structure and its effect on mechanical properties of isotactic polypropylene in a wide range of temperatures, on the grafting of three-dimensional polymers to glass fiber. TAB

**N66-13838*#** Stanford Research Inst., Menlo Park, Calif.

**DEVELOPMENT OF SPECIFICATIONS FOR POLYMERIC MATERIALS Interim Report No. 1, Jun. 1964–Aug. 1965**

9 Aug. 1965 84 p refs Prepared for JPL

(Contracts NAS7-100; JPL-950745)

(NASA-CR-68784) CFSTI: HC $3.00/MF $0.75 CSCL 11I

A summary is given of work leading to recommendations for preparation of specifications for selected polymeric materials to be used in spacecraft. A design drawing and photographs are presented for a standardized vacuum-weight-loss apparatus and suggestions are made toward a standardized

thermal-vacuum weight-loss procedure. Procedures and data are summarized for chemical and physical testing of a series of epoxy adhesives. A discussion is given of exploratory work on the weight-loss behavior of epoxy, silicone, and fluorocarbon polymers in vacuo at temperatures of 150° C and 200° C. Author

**N66-13856#** Sexta, S. A., Bagneux (France).
**APPLICATION OF STRAIN GAGES AT HIGH TEMPERATURE. PART I: CEMENTS [L'EMPLOI DES JAUGES DE DEFORMATION A HAUTE TEMPERATURE. 1ère PARTIE: LES CIMENTS]**
B. Legrand, J. Toux, P. Bonnet, and M. Grin (EURATOM) Brussels, EURATOM, 1965 31 p In FRENCH
(Contract EURATOM-075-62-7 ORGF)
(EUR-2473.f) CFSTI: HC $2.00/MF $0.50

Some commercial cements were tested under mechanical and thermal stresses. The value of resistance to isolation of the cements in dependence on temperature was plotted. At temperatures higher than 500° C, practically no cement has a resistance to ground sufficient for precise measurements in connection with strain gages. Author (NSA)

**N66-13872#** Bendix Corp., Kansas City, Mo.
**EFFECT OF MOLECULAR STRUCTURE ON THE THERMAL AGING PROPERTIES OF FLEXIBLE URETHANE FOAMS**
C. H. Smith and S. L. De Gisi 15 Sep. 1965 19 p refs
(Contract AT(29-1)-613)
(BDX-613-75; CONF-651107-1) CFSTI: HC $1.00/MF $0.50

A series of flexible urethane foams was formulated from diisocyanate terminated polyether prepolymers, using both a polyether diol and an ethylenediaminetetraglycol as extenders. The long term compression set characteristics and the compression deflection properties of these foams were studied. The swelling effect in a solvent, the free isocyanate content, and the role of a carbon black filler on the flexible urethane foam formulation were also evaluated. It was concluded that the total amount of diisocyanate used in the formulation, rather than a variation in the type of isocyanate, has the greatest influence on molecular structure. Author (NSA)

**N66-13903#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**PROBLEM OF RADIATION STABILITY OF ION EXCHANGE RESINS. II: RADIATION DAMAGE TO CERTAIN POLYMERIZATION ANIONITES. [K VOPROSU O RADIATSIONNOI USTOICHIVOSTI IONOOBMENNYKH SMOL. SOOBSHCHENIE II. O RADIATSIONNOM POVREZHDENII NEKOTORYKH POLIMERIZATSIONNYKH ANIONITOV]**
P. D. Novikov 1964 37 p refs In RUSSIAN
(IAE-788) CFSTI: HC $2.00/MF $0.50

Comparative data are presented on the radiation stability of strongly basic anion resins of polymerization type AV-19, AV-21, and AV-27, differing in the chemical structure of the three-dimensional form and of the functional groups. It is shown that the anion resin AV-21 has a large radiation stability based on the acenaphthylene and divinylbenzene copolymer. Results of studies of the nature of water-soluble products of radiolysis of the above anion resins and the anion resin AV-17 are also presented. Author (NSA)

**N66-13917#** Pennsylvania State Univ., University Park. Dept. of Physics.
**EFFECT OF RADIATION ON DYNAMIC PROPERTIES OF HIGH POLYMERS Final Report**
Richard N. Work Sep. 1965 14 p refs
(Contract AT(30-1)-1858)
(NYO-1858-1) CFSTI: HC $1.00/MF $0.50

Significant developments in studies on the solid state behavior of polymeric materials and the effects of radiation on their properties and structure are briefly reviewed. 89 references are cited. NSA

**N66-13960#** Texas Univ., Austin. Structural Mechanics Research Lab.
**THE EFFECTS OF SHAPE OF LOAD PULSE ON SHOCK-MITIGATING CHARACTERISTICS OF A STYROFOAM PLASTIC**
Robert I. Carr, Ervin S. Perry, E. A. Ripperger, and J. Neils Thompson Jul. 1965 40 p refs
(Contract DA-22-079-ENG-393)
(AD-623317) CFSTI: HC $2.00/MF $0.50

The dynamic cushioning characteristics of confined specimens of Styrofoam HD-1 are presented in the form of stress-strain curves and stress-time curves. The specimens demonstrated identical stress-strain curves from various impulse loadings on the HYGE shock tester and from static tests. Variations in the rise time and pulse durations of the HYGE wave forms were accompanied by like variations in rise times and durations of the crushing stress-time curves. Styrofoam HD-1 crushed initially at approximately 46 psi and bottomed at about 50 percent strain with an energy dissipation at bottoming of approximately 3 ft-lb per cubic inch. Author (TAB)

**N66-14096#** Atomic Weapons Research Establishment, Aldermaston (England).
**THE PARTICULAR CONTRIBUTION OF EXPOSED SURFACE BUBBLES TO THE TRUE SURFACE AREA OF MACHINED RIGID FORMS**
H. Briscall Jul. 1965 18 p refs
(AWRE-O-32/65) HMSO: 4s 6d

An equation was derived, showing that the increase in area caused by random spherical bubbles breaking an otherwise plane solid surface is related to the diameters of the circles of intersection formed by the plane cutting the bubbles. The equation was applied to machined plastic foams over a wide density range and the roughness factor ($R_B$) caused by bubbles in the surface was shown to have values between 1 and 3. $R_B$ plotted against foam density gives a straight line. The contribution of the roughness of the solid material between the bubbles to the true surface area of the machined foams is not considered in this report. Author

**N66-14227#** West Virginia Pulp and Paper Co., Charleston, S. C.
**ADSORPTION-DESORPTION PROPERTIES OF SORBENTS Bimonthly Progress Report, 19 Jul.-18 Sep. 1964**
A. W. Loven and F. J. Vermillion 6 Oct. 1964 20 p refs
(Contract DA-18-035-AMC-106(A))
(BMPR-5; AD-607076) CFSTI: HC $2.00/MF $0.50

Water adsorption and desorption isotherms at 25C are reported for a coal-base granular activated carbon, activated carbon, activated carbon fibers made from Fortisan and viscose rayons, and highly activated coconut shell charcoals. Isotherm shapes correlate well with pore structures. Observed saturation capacities for water imply that the density of adsorbed water is approximately 10% less than that of liquid water. Further adsorption and desorption isotherms of dimethyl methylphosphonate, DMMP, on a highly activated coconut shell charcoal are reported. These measurements confirm a

previously reported reduction in DMMP capacity upon grinding the granular sample to a fine powder. Isosteric heats of adsorption of DMMP on the coconut shell charcoals are seen to be significantly lower than on the other carbons listed above which were previously studied. This is consistent with observed differences in pore structure and isotherm steepnesses among the samples. Apparatus has been installed and calibrated for flow adsorption evaluation of sorbent pads. This embodies a converted E-2 canister tester in conjunction with a gas chromatograph. A gas chromatographic method for the determination of low concentrations of DMMP in air is described. Author (TAB)

**N66-14265#** Bureau of Mines, Albany, Oreg.
**DEVITRIFICATION OF A LITHIUM DISILICATE GLASS**
Henry M. Harris, John E. Kelley, and Hal J. Kelly 1965 18 p refs
(BM-RI-6711)

A glass containing approximately 17 percent lithia and 83 percent silica was investigated to establish a method of devitrifying cast and rolled shapes. Glass shapes with high strength were made by melting, forming, and rapid cooling of the composition, and the shapes subsequently were converted to a crystalline condition by heat treatment. The best devitrification schedule included rapid cooling of the glass to below 300° C, followed by reheating at a rate of 50° to 4000° C per hour, depending on the size of the shape, followed by a dwell of 60 to 70 hours at 500° C and another period of 15 hours at 800° C. Attempts to use faster heating rates or slow cooling to accomplish devitrification resulted in deformation of the shapes. The crystalline shapes had flexural strengths that averaged over 33 000 psi, achieved with an annealing time of 60 to 70 hours at 500° C. Author

# 19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

**N66-13306** Joint Publications Research Service, Washington, D. C.
**RECOGNITION OF ABSTRACT SHAPES AS A PROBLEM IN LINEAR PROGRAMMING**
A. A. Pervozvanskiy *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 58–63 refs (See N66-13301 04-10) CFSTI: $6.00

The problem of finding a separating hyperplane which arises in the theory of recognition of abstract shapes is formulated in the form of the problem of linear programming. It is shown that the procedures of linear programming for a finite number of iterations permit establishment of the possibility or impossibility of separation of objects from a learning series, and finding the measure of "indistinguishability." Author

**N66-13314** Joint Publications Research Service, Washington, D. C.
**ON REPRESENTATION OF NATURAL NUMBERS BY A SYSTEM OF RING INDICATORS WITH MUTUALLY DISJOINT NUMBERS OF DIGITS**
A. N. Divovarov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 143–153 refs (See N66-13301 04-10) CFSTI: $6.00

Some problems are investigated in the application of systems or ring indicators with mutually disjoint numbers of digits, the code combinations of which are described by linear Diophantine equations. It is shown that when being used for the control of a time function (or the number of cycles) such systems have a simpler structure than binary and decimal counters. A tabular procedure is proposed for solution of the linear Diophantine equations. Author

**N66-13328** Joint Publications Research Service, Washington, D. C.
**ON A PROBLEM IN NONLINEAR PROGRAMMING**
I. S. Mosevitskiy and S. B. Elyukim *In its* News of the Acad. of Sci. 30 Nov. 1965 p 281–285 ref (See N66-13301 04-10) CFSTI: $6.00

To find the solution of a system of nonlinear algebraic or transcendental equations or for the optimization of some function of the variables of the problem, a unique numerical procedure of sequential approximations is proposed. This is a generalization of the Newton tangent method and the gradient method for finding the extremum. Author

**N66-13329** Joint Publications Research Service, Washington, D. C.
**DIAGRAMS OF RANDOM NUMBER GENERATORS USING POISSON FLOW PROPERTIES**
I. A. Ushakov and B. V. Panyukov *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 286–293 refs (See N66-13301 04-10) CFSTI: $6.00

Data transmitters proposed for obtaining random numbers with uniform distribution are a system with two counters and another system with one counter and two gate registers. A generator of independent random numbers with given distribution may be realized by use of a memory of any type; and discussions are included for memory units in general and, specifically, for a magnetic drum memory. The systems proposed are considered to be insensitive to variations in intensity of random pulse flow. It is pointed out, however, that the output frequency of independent random numbers cannot be higher than the frequency of the cyclical series. Use of a buffered memory is considered necessary since the random numbers at the transmitter output are irregular when the analyzer sends out inhibit signals in the absence of a number or the presence of more than one number. M.W.R.

**N66-13380*#** Lehigh Univ., Bethlehem, Pa. Inst. of Research.
**FIRST-OCCURRENCE TIME OF HIGH-LEVEL CROSSINGS IN A CONTINUOUS RANDOM PROCESS**
James R. Rice and Ferdinand P. Beer 15 Mar. 1965 47 p refs Submitted for Publication
(Grant NsG-466)
(NASA-CR-62797) CFSTI: HC $2.00/MF $0.50 CSCL 12A

This paper deals with the statistical distribution of the first-occurrence and first-recurrence times of the crossing of a given level in a continuous random process. Approximate forms of the first-occurrence and first-recurrence time densities are found by considering the successive crossings to form a renewal process. A relatively simple exponential distribution is found to give an appropriate representation of the limiting case when the crossings of the level under consideration are statistically rare events. Numerical examples are worked out for some stationary Gaussian processes. The work reported here is of use in evaluating survival probabilities for randomly excited mechanical systems subject to failure upon occurrence of a sufficiently high load. Author

**N66-13400*#** Iowa State Univ. of Science and Technology, Ames.
**A HYPERGEOMETRIC MEAN VALUE**
B. C. Carlson [1963] 10 p refs
(Grant NsG-293)
(NASA-CR-56922) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The hypergeometric mean value is generalized from the hypergeometric function without loss of homogeneity and the properties of the hypergeometric mean value are achieved.
E.E.B.

**N66-13452#** Army Missile Command, Huntsville, Ala. Translation Branch.
**ON A PROPERTY OF SIGN-SYMMETRIC MATRICES**
D. M. Kotelyanskii Aug. 1965 8 p refs Transl. into ENGLISH from Usp. Mat. Nauk (Moscow), v. 8, no. 4, 1953 p 163–167
(RSIC-444; AD-470557)

Matrices are examined in which the requirement that the product of any two minors, symmetric relative to the leading diagonal, is nonnegative and is propagated only on minors with dispersions equal to 1; for example, minors obtained from the principals by cancellation of one horizontal and one vertical with different indices. It is noted that the matrix comprising such a weak sign-symmetry still conserves the known property of symmetrical matrices, namely the invariance of the number of alternations in the series of successive principal minors.
C.T.C.

**N66-13453#** Army Missile Command, Huntsville, Ala. Translation Branch.
**ON A SPECIAL CLASS OF DETERMINANTS CONNECTED WITH KELLOG'S INTEGRAL KERNELS**
F. R. Gantmacher and M. G. Krein Aug. 1965 13 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 42, no. 4, 1935 p 501–507
(RSIC-443; AD-471502)

This report is on a special class of determinants connected with Kellog's integral kernels. This class of kernels is characterized by two inequalities which is valid with any natural (n). The theory of this class is investigated and applied to the study of the theory of vibrations and of linear differential equations of the highest orders.
R.C.S.

**N66-13473#** Army Missile Command, Huntsville, Ala. Translation Branch.
**SOME METHODS OF STUDYING BURMESTER CURVES**
Ya. L. Geronimus 16 Sep. 1965 6 p Transl. into ENGLISH from Tr. 3-go Soveshoniya; Mashgiz, Miscow, 1963
(RSIC-460; AD-473160)

The role of Burmester curves: a center point curve and a circle point curve, in problems dealing with the mechanics of a geometrical synthesis is well known; these curves have to be plotted along the points. We will examine one method which will make it possible to investigate easily their properties and to obtain comparatively simple formulas which will enable us to find by an analytic method those parameters, along which the curves are plotted through the points.
Author (TAB)

**N66-13505*#** Research Triangle Inst., Durham, N. C.
**ON CERTAIN FUNCTIONALS OF NORMAL PROCESSES Technical Report No. 1**
M. R. Leadbetter and J. D. Cryer Sep. 1964 14 p refs
(Contract NASw-905)
(NASA-CR-68700) CFSTI: HC $1.00/MF $0.50 CSCL 12A

An expression is derived for the upper bounds for systems engineering reliability. Theoretical results on probabilistic modeling are documented. The basic research studies consist mainly of investigations in curve, level, and zero crossings by certain normal stochastic processes (both stationary and non-stationary). Such investigations provide measures of the quality of performance and the reliability of certain complex systems. The time which the process of interest spends outside given (undesirable) levels and related random variables is also discussed.
M.R.W.

**N66-13515#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**GENERALIZATION OF AN A. M. LIAPUNOV THEOREM ON THE CONSTRUCTION OF THE LIAPUNOV FUNCTION FOR A STABLE LINEAR SYSTEM**
Iu. I. Alimov [1964] 2 p refs Transl. into ENGLISH from Tr., Ural Polytech. Inst. (USSR), no. 139, 1964 p 50–51

Consideration is given to a Liapunov V function for asymptotically stable linear systems with constant coefficients whose total derivative $\dot{V}$ with respect to time is a sign-definite form. A theorem is proved in which the fundamental content is a further weakening of the requirements on the derivative $\dot{V}$.
C.T.C.

**N66-13518*#** RAND Corp., Santa Monica, Calif.
**RELIABILITY GROWTH DURING A DEVELOPMENT TESTING PROGRAM**
Richard E. Barlow and Ernest M. Scheuer Oct. 1965 21 p refs
(Contract NASr-21(11))
(NASA-CR-68694; RM-4317-1-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 12A

This study examines the problem of estimating the reliability of a system that is undergoing testing. In this program, changes are made to the system periodically in order to increase its reliability. This study assumes that these changes are at least not deleterious, but it does not assume that modifications cause reliability growth according to a prescribed functional form. The method described requires that each failure be classified either as inherent or as reflecting a correctable cause. The study supposes that the program is conducted in K stages, with similar items being tested in each stage. For each stage, the number of inherent failures, of assignable cause failures, and of successes is recorded. It is supposed that the probability of an inherent failure remains the same throughout the test program and that the probability of an assignable cause failure in the i-th stage does not increase from stage to stage of testing. This memorandum obtains maximum likelihood estimates of the probabilities subject to the condition that they be non-increasing.
Author

**N66-13578#** Research Analysis Corp., McLean, Va.
**THE SEQUENTIAL UNCONSTRAINED MINIMIZATION TECHNIQUE FOR CONVEX PROGRAMMING WITH EQUALITY CONSTRAINTS**
Anthony V. Fiacco and Garth P. Mc Cormick Apr. 1965 26 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-155; AD-623093) CFSTI: HC $2.00/MF $0.50

This paper extends the sequential unconstrained minimization technique for nonlinear programming to include problems where the constraints are a mixture of inequalities and equalities. Theorems indicating the dual nature of the method and the solution of a subproblem are given. Finally, the theoretical basis for a k-point extrapolation procedure is established.
Author (TAB)

**N66-13609#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**A CLASS OF VARIATIONAL PROBLEMS IN SEARCH THEORY AND THE MAXIMUM PRINCIPLE**
E. J. Beltrami and R. Mc Gill Jun. 1965 22 p refs
(RM-281J)

In this paper we consider certain nonlinear and constrained variational problems which occur in the theory of search. The problems are definitely of a nonclassical variety, but, by using a device of R. Courant, a sequence of unconstrained variational problems is generated, the solutions of which converge to the solution of the constrained problem. The maximum principle of L. Pontryagin et al., is then utilized to construct a corresponding sequence of nonlinear, two-point boundary value problems such that a solution to the variational problem will then necessarily satisfy the boundary value problem. An effective computational method, based on the notion of a generalized Newton-Raphson operator, is then applied to solve iteratively, in a rapid and accurate manner, the nonlinear boundary value problem; under suitable assumptions, this method yields solutions to the variational problem. The technique is illustrated in several examples. Author

**N66-13610#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**COMPLEX NORMALIZATION OF SCATTERING MATRICES AND THE PROBLEM OF COMPATIBLE IMPEDANCES**
M. R. Wohlers Jun. 1965 37 p refs
(RE-214J)

A new complex normalization procedure for scattering matrices is reviewed and an existence theorem is presented for determining whether a given matrix is the scattering matrix of a passive system with a known complex normalization. The new technique is applied to the problem of impedance transformation using lossless networks (compatible impedances), and it is shown to lead to its complete solution. Examples which illustrate the procedure are given. Author

**N66-13691#** C-E-I-R, Inc., Beverly Hills, Calif.
**ON NON-REGULAR ESTIMATION. MINIMUM VARIANCE BOUNDS AND THE PEARSON TYPE III DISTRIBUTION**
W. R. Blischke, A. M. Glinski, M. V. Johns, Jr., P. B. Mundle, and A. J. Truelove Wright-Patterson AFB, Ohio, ARL Sep. 1965 105 p refs
(Contract AF 33(615)-1062)
(ARL-65-177; AD-622274) CFSTI: HC $4.00/MF $0.75

This project concerns general investigations on the theory of non-regular estimation and particular investigations leading to asymptotically efficient estimation for the parameters of the Pearson Type III distribution and also for other distributions, including Types I and V of the Pearson system, the Weibull distribution and a generalization of the gamma distribution. In all of these examples the difficulty is in estimating the location parameter. In each case for a non-trivial subset of the parameter space, standard techniques, including those derived specifically for the non-regular case, for determining a lower bound on the variance of an unbiased estimator result in an inequality which states that the variance of all such estimators is non-negative. New bounds, which yield uniformly non-trivial results, have been constructed. These have been applied to the above examples. Some suggestions for constructing estimators whose variance achieves at least the order of magnitude of these bounds are offered. Author (TAB)

**N66-13694#** System Development Corp., Santa Monica, Calif.
**A GRADIENT TECHNIQUE OF ADAPTIVE MONTE CARLO**
E. L. Pugh 8 Sep. 1965 23 p refs Supersedes SP-1921 (SP-1921/000/01; SP-1921; AD-621997) CFSTI: HC $1.00/MF $0.50

A technique of Monte Carlo estimation is presented which is 'adaptive' in the sense that its efficiency increases as the sampling proceeds. It is based on sequentially estimating the gradient of the variance and following the path of steepest descent. The technique is applied to a problem of estimating the survival probability of a repairable machine. Author (TAB)

**N66-13720*#** California Univ., Berkeley. Operations Research Center.
**CONSERVATIVE TOLERANCE AND CONFIDENCE LIMITS**
Richard E. Barlow Aug. 1965 22 p refs Supported by NASA
(Contracts DA-31-124-AROD-331; Nonr-3656(18))
(NASA-CR-68900; ORC-65-30; AROD-5307-2; AD-621864) CFSTI: HC $1.00/MF $0.50 CSCL 12A

This paper extends the validity of exponential tolerance and confidence limits, under certain restrictions, to the class of distributions with monotone failure rate. In particular, the usual exponential lower tolerance limit is shown to be conservative for the increasing failure rate class of distributions in the range of population coverages and confidence coefficients of practical interest. Conservative confidence limits are also obtained on tail probabilities and moments. Author (TAB)

**N66-13725#** Cambridge Language Research Unit (England). Information Structures Unit.
**THE CALCULATIONS OF CYCLE LENGTHS**
Ted Bastin and Michael Roy 1 Dec. 1964 19 p refs
(Grant AF-EOAR-64-63)
(AFOSR-65-1322; AD-622584) CFSTI: HC $1.00/MF $0.50

A complete set of calculations of cycles of all levels was devised so that comparison with experiment could be made by selection according to special rules from the totality of cycles. The levels of interest are those of increasing descriptive power such as may derive from infinitely proceeding sequences as in the inflow of data into a hierarchial-type information processing system. The algebraic hierarchy generated consists of judgments that can be made about the future development of the sequences expressed in the form of matrix transforms of vectors over the field. Sequences are said to cycle in such a form as V, AV, A squared V ... A to the jth power V ..., where the sequence must contain the term A to the kth power V so that A to the kth power V = V. By putting this property of a cycling sequence in terms of the hierarchial concept, there results: To every vector at level K, there corresponds a cycle at level K minus 1. Calculations were made by their multiplication and enumeration, and a standard form for the matrix and initial vector was used which would generate all possible cycles. The spectrum of cycles has been thought of chiefly in connection with the spectrum of masses of the elementary particles. TAB

**N66-13770#** North Carolina Univ., Chapel Hill.
**ESTIMATION OF THE PARAMETERS OF THE EXTREME VALUE DISTRIBUTION BY ORDER STATISTICS**
Khatab M. Hassanein [1964] 80 p refs
(Grant DA-ARO(D)-31-124-G-432)
(AROD-2776-17; AD-622257) CFSTI: HC $3.00/MF $0.75

An estimation of the parameters for the first type (or exponential type) of asymptotic distribution, this paper deals with (1) the best linear unbiased estimate for n < or = 6 (largest value)

and the case of missing data. (2) the nearly best linear unbiased estimate for n < or = 25(n = 1 (1) 10 (5) 25) with all possible cases of singly and doubly censored samples, and (3) estimating the percentage points. Author(TAB)

**N66-13806#** Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
**PERCENTAGE POINTS OF STATISTICS FOR TESTING RANDOMNESS OF DIRECTIONS**
Michael A. Stephens Jun. 1965 9 p refs
(Contract Nonr-4010(09))
(TR-27; AD-622994) CFSTI: HC $1.00/MF $0.50

The paper gives the percentage points of two statistics which would be used in testing for randomness of three dimensional vectors against one of two specified spherical distributions as alternative. Author(TAB)

**N66-13813#** Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
**TESTS FOR THE DISPERSION, AND FOR THE MODAL VECTOR OF A UNIMODAL DISTRIBUTION ON A SPHERE**
M. A. Stephens (Mc Gill Univ.) Aug. 1965 35 p refs
(Contract Nonr-4010(09))
(TR-31; AD-622995) CFSTI: HC $2.00/MF $0.50

The theory and tables are given for testing hypothesis concerning the parameters of the unimodal Fisher spherical distribution. Author(TAB)

**N66-13817#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**SEQUENTIAL TESTING WHEN ONLY THE ALTERNATE HYPOTHESIS IS COMPOSITE**
Eugene Simaitis (M.S. Thesis) Jun. 1965 61 p refs
(GRE/MATH/64-10; AD-622029) CFSTI: HC $3.00/MF $0.75

This thesis is a discussion of sequential analysis when the alternative hypothesis is composite. Sequential testing with composite alternatives is introduced through decision theory and sequential tests of simple hypotheses. The weighted average and maximum methods are presented as solutions to the problem of testing with composite alternatives. The existence of optimum weight functions in some special but important cases is shown. A procedure is demonstrated for constructing a sequential test when one critical point in the statement of the alternative hypothesis is given. The procedure is illustrated by two examples involving one- and two-parameter distributions. Author(TAB)

**N66-13883#** Stanford Univ., Calif. Linear Accelerator Center.
**POISSON EQUATION SOLVING PROGRAM**
William B. Herrmannsfeldt Sep. 1965 35 p refs
(Contract AT(04-3)-400)
(SLAC-51) CFSTI: $2.00

The general characteristics of a pair of computer programs designed to solve applications of Poisson's equation are given. The programs are specifically written to solve electron trajectories in electrostatic focusing systems and to solve for magnetic fields. The programs could be adapted to other applications such as heat transfer problems. Author

**N66-13896#** Brown Univ., Providence, R. I.
**REMARKS ON HIGHER ORDER SPECTRA**
M. Rosenblatt [1965] 14 p refs Sponsored by NR
(AD-620905) CFSTI: HC $1.00/MF $0.50

Consideration is given to higher order spectra of stationary vector-valued processes. Basic concepts are that $\{x_a(t); a = 1, \ldots, k\}, -\infty < t < \infty$, is a column k-vector of real valued random processes that are jointly strictly stationary with respect to the time variable t. For convenience, it is assumed that all moments of the processes exist and that the processes are continuous in mean. Also, $E\, x_a(t)$ is set equal to zero, where $a = 1, \ldots, k$. The process $x(t) = (x_a(t))$ has the Fourier representation on the assumption of existence of second order moments. C.T.C.

**N66-13970#** California Univ., Berkeley. Operations Research Center.
**ON THE KUHN-TUCKER THEOREM**
Jean Abadie Jun. 1965 27 p refs
(Contracts DA-31-124-ARO(D)-331; Nonr-222(83); Grant NSF GP-2633)
(ORC-65-18; AROD-5307-4; AD-623310) CFSTI: HC $2.00/MF $0.50

The general programming problem considered has the form: minimize f (x) subject to (1) $g_i(x) = 0$, $i = 1, 2, \ldots, m$. The regularity condition of Cottle is first generalized so that any linear system satisfies a (new) regularity condition. It is then proven that this regularity condition is actually a sufficient criterion for a certain weakened form of the Kuhn-Tucker constraint qualification property. Finally, a further generalization of the latter property is given. Author(TAB)

**N66-13979#** Research Analysis Corp., Mclean, Va.
**MODULAR DESIGN, GENERALIZED INVERSES, AND CONVEX PROGRAMMING**
Abraham Charnes (Northwestern Univ.) and Michael J. L. Kirby Jul. 1965 17 p refs Prepared in Cooperation with Northwestern Univ.
(Contracts DA-44-188-ARO-1; Nonr-1228(10))
(RAC-TP-157; AD-623097) CFSTI: HC $1.00/MF $0.50

It is shown that a modular design problem can be transformed into a problem of minimizing a separable convex function subject to linear equality constraints and nonnegativities. This transformation is effected by using a generalized inverse of the constraint matrix. Moreover the nature of the functional and the constraints of the separable problem are such that a good starting point for its solution can be obtained by solving a particular transportation problem. Several possible methods for solving the separable problem are discussed, and the results of our computational experience with these methods are given. It is also shown that the modular design problem can be viewed as a special case of a large class of general engineering design problems that have been discussed in the literature. Author(TAB)

**N66-13984#** Purdue Univ., Lafayette, Ind. Dept. of Statistics.
**OPTIMAL EXPERIMENTAL DESIGNS**
Samuel Karlin (Stanford Univ.) and William J. Studden Oct. 1965 71 p refs Prepared in part at Stanford Univ. *Its* Mimeograph Ser. No. 57
(Contracts Nonr-225(28); Nonr-1100(26); Grant NSF GP-2487)
(AD-623216) CFSTI: HC $3.00/MF $0.75

This paper presents a number of results concerning the theory of the optimal design of experiments initiated and principally developed by Elfving, Kiefer and Wolfowitz. The paper contains approximately half expository and half new material. The proofs are mostly new and presented in a unified manner. The paper contains material on the estimation of linear functions of the regression parameters, extrapolation, minimax estimation, admissible designs and some quadratic loss problems. Author(TAB)

**N66-13988#** State Univ. of New York, Stony Brook. Coll. of Engineering.
**THE DISTRIBUTIONAL HANKEL TRANSFORMATION**
**Seventh Scientific Report**
A. H. Zemanian 9 Aug. 1965 60 p refs *Its* Rept.-44
(Contract AF 19(628)-2981)
(AFCRL-65-646; AD-623124) CFSTI: HC $3.00/MF $0.75

The Hankel transformation is generalized in a distributional way, something that apparently has not been done before. Two different procedures are used to accomplish this. In the first procedure a topological linear space of testing functions is constructed for which the $\mu$-th order Hankel transformation is a topological automorphism. The dual space consists of the $\mu$-th order Hankel-transformable distributions. The distributional Hankel transformation is then defined by generalizing a variation of Parseval's formula. It turns out that the distributions to which this transformation may be applied must be of slow growth. The second procedure yields a more general result in that there is no restriction on the rate of growth of the distributions that are to be transformed. Here again, Parseval's formula is used to define the generalized Hankel transformation, but in contrast to the previous case the testing functions for the distributions under consideration are required to have bounded supports. The Hankel transforms then turn out to be continuous linear functionals on certain classes of analytic functions. Several applications to differential equations containing Bessel-type differential operators are also given. Author (TAB)

**N66-14058*#** National Aeronautics and Space Administration, Washington, D. C.
**HYPERGEOMETRIC FUNCTIONS AND VARIOUS RELATED PROBLEMS [DELLE FUNZIONI IPERGEOMETRICHE E DI VARIE QUESTIONI AD ESSE ATTINENTI]**
S. Pincherle Dec. 1965 101 p refs Transl. into ENGLISH from Giorn. Matematiche Battaglini (Naples), v. 32, 1894 p 209–291
(NASA-TT-F-9700) CFSTI: HC $4.00/MF $0.75 CSCL 12A

The author presents a series of lessons dealing with the theory of hypergeometric functions based on the principles of analytic function theory. Then dealt with successively are the principal properties of hypergeometric series, linear difference equation and second order linear difference equation, linear differential equations and regular linear differential equations and their application to the hypergeometric equation. Author

**N66-14167#** Claremont Men's Coll., Calif.
**ON THE REPRESENTATION OF CERTAIN NONLINEAR BOUNDARY VALUE PROBLEMS FOR HARMONIC FUNCTIONS BY SYSTEMS OF EQUATIONS**
John A. Ferling May 1964 10 p refs
(Grants Nonr(G)-0004-64)
(AD-601440)

A restricted nonlinear boundary value problem for a harmonic function is represented by a system of equations, and an example of the usability of the approach is demonstrated by a problem to which the exact solution is known. A more general problem for which the exact solution is known is also given to demonstrate the usability of the system. The region considered in the problem is a unit disc, and the problem solution has applicability to the theory of water waves, jets, and heat, and radiation. L.S.

**N66-14313#** Research Analysis Corp., McLean, Va.
**OPTIMAL DECISION RULES FOR THE E MODEL OF CHANCE-CONSTRAINED PROGRAMMING**
Abraham Charnes (Northwestern Univ.), and Michael J. L. Kirby Jul. 1965 37 p refs
(Contracts DA-44-188-ARO-1; Nonr-1228(10))
(RAC-TP-166; AD-623094) CFSTI: HC $2.00/MF $0.50

The first five sections of this paper contain an introduction to the topic of chance-constrained programming. Then the general n-period expectation-objective model of chance-constrained programming is presented and certain necessary conditions are established for decision rules to be optimal for such a model. The question of the consistency of the constraints and the finiteness of the optimal value of the objective function for such problems is discussed and several methods of resolving these questions are presented. The simplification that results when the chance-constrained problem is treated as a problem of linear programming under uncertainty is also discussed. The paper is concluded by solving two two-stage problems.
Author (TAB)

# 20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

**N66-13402** Joint Publications Research Service, Washington, D. C.
**DEVELOPMENT OF METEOROLOGY IN RECENT YEARS**
Tu-Cheng Yeh *In its* Transl. on Communist China's Sci. and Technol., No. 241 22 Nov. 1965 p 15–25 (See N66-13401 04-13) CFSTI: $2.00

The various aspects of observational technology and their application in meteorological sciences are presented. A general summary of the state-of-the-art in atmospheric observations is given. Discussed are satellite radiosonde applications, radar network stations, rain detection by centimeter waves, weather satellites, electro-magnetic waves in the atmosphere, the automatization of weather forecasting, and the utilization of super-long waves to obtain dynamic atmospheric patterns.
G.G.

**N66-13421** Joint Publications Research Service, Washington, D. C.
**A NUMERICAL EXPERIMENT OF CUMULUS DEVELOPMENT**
Hsiao-P'ing Chou, Hsing-Sheng Li, Yao-K'o Chang, and Tseng-Chin Kung *In its* Transl. on Communist China's Sci. and Technol., No. 233 5 Nov. 1965 p 33–51 refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v. 34, no. 4, Nov. 1964 p 475–484 (See N66-13419 04-34) CFSTI: $3.00

A three-dimensional axial-symmetric model of cumulus development is presented herein, with consideration given to the effect of condensation feedback on the field of motion. In this experiment it has been assumed that both vertical lapse rate and relative humidity of the circumstances are decreased with height. A calculation computed by the electronic computer shows that, for an atmospheric temperature disturbance of about 1° C, a cumulus of some 5–6 kms in thickness could be developed in about 20 minutes. In the lower part of the cloud there is a moist-unstable region which becomes quasi-steady in its intensity and size. The field of motion and the field of temperature in this region are also approximately steady even in the late stage of development of the cumulus. However, in the upper moist-stable region of the cloud, the flow and

temperature fluctuate greatly. In this region the convective elements from the lower part of the cloud oscillate and gradually dissipate when they reach the top of the cumulus. All these are in accord with the phenomena observed in the atmosphere.
Author

**N66-13464#** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
**AEROBEE NASA 4.147 CG (22 SEPTEMBER 1965) Meteorological Data Report**
Marjorie Mc Lardie Hoidale Oct. 1965 32 p refs
(ERDA-347; AD-472564)

Meteorological data gathered for the launching of Aerobee NASA 4.147 CG are presented for the National Aeronautics and Space Administration and for ballistic studies. The data appear, along with calculated ballistic data, in tabular form.
Author (TAB)

**N66-13476*#** National Aeronautics and Space Administration, Washington, D. C.
**EXPERIENCE IN ANALYSING INFRARED PICTURES OF CLOUDS OBTAINED BY THE METEOROLOGICAL SATELLITE "NIMBUS-1" [OPYT ANALIZA INFRAKRASNOGO IZOBRAZHENNIYA OBLACHNOSTI POLUCHENNOGO PRI POMOSHONI METEOROLOGICHESKOGO SPUTNIKA "NIMBUS-1"]**
I. P. Vetlov, V. L. Gayevskiy, L. N. Guseva, Ye. P. Dombkovskaya, K. Ya Kondrat'yev et al Nov. 1965 16 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 9, 1965 p 20-26
(NASA-TT-F-8776) CFSTI: HC $1.00/MF $0.50 CSCL 04B

Results are presented of a comparative analysis of ordinary meteorological data and data on clouds obtained from the Nimbus I satellite with the aid of infrared apparatus and represented by two infrared negatives obtained at midnight on 2 and 6 September 1964 over the Soviet Union. It was concluded that an infrared picture obtained from a satellite yields a more complete and integrated picture of cloud distribution than a synoptic map. In a number of cases, data on the radiation balance can be used to improve some aspects when interpreting satellite observations.
R.N.A.

**N66-13602#** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate.
**A STUDY OF THE FEASIBILITY OF USING RADAR CHAFF FOR STRATOSPHERIC TEMPERATURE MEASUREMENTS**
James B. Mason Fort Monmouth, N. J., Army Electron. Labs., Nov. 1965 27 p refs
(ECOM-5012; AD-473747)

A method of measuring temperature in the stratosphere through use of a passive sensor was explored. The sensor in this case was a cloud of radar chaff, a large number of small radar reflective cylinders cut to specified lengths so that they act as half-wave dipoles for the particular radar frequency in use. The possibility of detecting frequency shifts in the maximum reflective intensity as a function of dipole length (which in turn is a function of temperature) was investigated. In addition, measurements with the M-33 radar system were made to determine the experimental feasibility of such a method for the determination of temperature. It is concluded that although a number of improvements could be made, the method is not feasible.
Author (TAB)

**N66-13621#** Naval Ordnance Test Station, China Lake, Calif.
**TETHERED AEROLOGICAL BALLOON SYSTEM Technical Progress Report 398**
Sheldon D. Elliott, Jr., J. M. Mc Kay, and R. B. Mc Kee Sep. 1965 43 p refs
(Contract AT(49-7)-2341; ARPA Order 594)
(NOTS-TP-3830; AD-621959) CFSTI: HC $2.00/MF $0.50

The tethered aerological balloon system (TABS) currently under development at NOTS is designed to maintain a captive balloon and payload at stratospheric altitudes for an indefinite period of time, taking advantage of the region of minimum wind velocity nearly always present at some level in the lower stratosphere. The system consists of (1) a conventional polyethylene balloon fitted with a self-deploying reefing system to reduce lateral drag; (2) an airborne telemetry-command package capable of monitoring up to six aerological or other parameters concurrently (additional packages may be distributed along the tether as needed); (3) a NOTS-developed glass fiber tether having a tensile strength comparable to that of steel, at one-fourth the latter's weight, fabricated in splice-free lengths exceeding 100,000 feet; and (4) a mobile ground vehicle from which all functions subsequent to launch can be performed, carrying a crew, control winch, and equipment to communicate with a ground telemetry and command station; the vehicle can run with the wind to reduce lateral drag loads on ascent of descent. The system is expected to become operational the fall of 1965. Various uses and possible further developments of such a stratospheric moored platform are discussed, including applications to manned systems.
Author (TAB)

**N66-13632*#** Florida State Univ., Tallahassee. Dept. of Meteorology.
**A STUDY OF A NON-DEEPENING TROPICAL DISTURBANCE**
Joanne Malkus Simpson, Michael Garstang, Margaret Chaffee, and Joseph Levine Aug. 1965 59 p refs
(Grants NsG-481; DA-AMC-28-043-64G5; Contracts Cwb-10693; Nonr-4071)
(NASA-CR-68561) CFSTI: HC $3.00/MF $0.50 CSCL 04B

Data from an experimental region based upon six islands of the Windward Group in the West Indies, a research vessel in the tropical Atlantic, an instrumented research aircraft, and TIROS VI and VII are used to study the structure of a specific disturbance which moved through the observational network during 15 and 16 August, 1963. Despite the fact that an unusual variety and amount of data is available, difficulties are encountered when an attempt is made to establish the physical and dynamic characteristics of the flow field and the attendant cloud and rainfall patterns associated with this disturbance. Taken individually, each source of data is found to be either inadequate or, in the light of other information, perhaps even misleading. When all sources are treated collectively a number of interesting features of the disturbance are illuminated. By and large, these results bear little resemblance to conventional tropical models such as the easterly wave or equatorial vortex.
Author

**N66-13682#** RAND Corp., Santa Monica, Calif.
**CLIMATE AND THE HEAT BUDGET OF THE CENTRAL ARCTIC**
J. O. Fletcher Oct. 1965 23 p refs Submitted for Publication
(P-3250; AD-622986) CFSTI: HC $1.00/MF $0.50

A detailed assessment is presented of each component of the heat budgets for the surface and for the earth-atmosphere system in the central Arctic, for both an ice-covered and an ice-free ocean. These estimates suggest that the annual heat balance at the surface for an ice-free Arctic would be near zero

rather than strongly positive as suggested by Donn and Shaw. The sources of this discrepancy are identified and discussed. The annual patterns of atmospheric cooling for both present and ice-free conditions are obtained as residuals. The relation of these patterns to general atmospheric circulation and glacier accumulation is discussed, with the conclusion that an open Arctic Ocean would be conductive to glacier accumulation in Canada and Scandinavia. Author (TAB)

**N66-13749#** American Meteorological Society, Boston, Mass.
**THE RELATION OF THE LIQUID-WATER CONTENT AND INTENSITY OF PRECIPITATION TO THE RADAR REFLECTIVITY OF THE METEOROLOGICAL ENTITY WITH VARIOUS PARAMETERS OF THE DROP-SIZE DISTRIBUTION [O SVIAZI VODNOSTI I INTENSIVNOSTI OSADKOV S RADIOLOKATSIONNOI OTRAZHAEMOST'IU METEOOB'EKTA PRI RAZLICHNYKH PARAMETRAKH RASPREDELENIIA KAPEL' PO RAZMERAM]**
A. G. Gorelik and G. A. Smirnova Bedford, Mass., AFCRL, Aug. 1965 13 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 48, 1963 p 98–105
(Contract AF 19(628)-3880)
(TR-481; AD-621422) CFSTI: HC $1.00/MF $0.50

Radar research on precipitation has indicated that for rain of low intensity, radar reflectivity is determined by drops of the size which make up the main water content of the rain. While a satisfactory approximation can be made for the drop-size distributions, the parameters of the distribution do not remain constant even for the same precipitation. Theoretical relations are evolved from which the liquid-water content and intensity of rain for any parameter of the drop-size distribution can be determined by using the radar reflectivity value. M.W.R.

**N66-13757#** Library of Congress, Washington, D. C. Aerospace Information Div.
**THE SOVIET 300-METER METEOROLOGICAL TOWER**
12 Feb. 1964 70 p refs Transl. into ENGLISH from Russian
(AID-U-64-6; AD-622233) CFSTI: HC $4.00/MF $1.00

Information presented herein has been extracted from open-source materials published in the Soviet Union between 1960 and 1963. Most of the scientific data reported in these sources represent observational data obtained at least one year, and, in some instances, as many as four years, prior to the date of publication. The report consists of two parts. Part A contains a brief, summarized description of (1) the 300-meter tower installation complex (physical plant); (2) the tower's organizational relationship to the USSR Academy of Sciences; (3) a list of scientific personnel known to be associated with the research programs at the tower; and (4) abbreviated statements of the research purposes envisaged for all tower installations in the Soviet Union as well as those envisaged for the 300-meter tower. TAB

**N66-13953#** Emmanuel Coll., Boston, Mass. Research Language Center.
**ICE CRYSTAL FORMATION MECHANISM AND DRY ICE EVAPORATION**
Po-Lin Chao Bedford, Mass., AFCRL, Aug. 1965 19 p refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v. 34, no. 1, 1964 p 87–93
(Contract AF 19(628)-5073)
(EMM-65-2; AD-623112) CFSTI: HC $1.00/MF $0.50

This paper discusses the mechanism for ice crystal formation in the neighborhood of dry ice. It studies the evaporating process of dry ice in supercooled clouds. The results agree with experiment. Author (TAB)

**N66-13966#** Texas A&M Research Foundation, College Station. Dept. of Oceanography and Meteorology.
**SOME REMARKS ON CYCLOGENESIS INDICATIONS AS DETERMINED FROM METEOROLOGICAL SATELLITE OBSERVATIONS, WITH APPLICATION TO THE GULF OF MEXICO AREA Final Report**
Aylmer H. Thompson, Malcolm E. Gosdin, and Raul E. Jimenez Aug. 1965 58 p refs
(Grant CWB-WBG-17)

Several of the current theories concerning the genesis of storms based on the dynamics of atmospheric motion suggest specific patterns of the vertical component of the motion. Since storm genesis usually is accompanied by sufficient moisture to yield clouds, such vertical motion patterns should be accompanied by cloud patterns recognizable in satellite pictures. These cloud patterns are deduced from the theories. The prime features of the patterns include evidence of a cloud band oriented roughly east-west and associated with a quasi-stationary or slowly moving baroclinic zone or front having a significant amount of moisture, and of a moving cloud mass upstream of the baroclinic zone. The latter cloud mass should be dense with a high upper surface, and may have evidence of a high-level circulation system. Actual cases are examined and the anticipated patterns found, though masking influences may cause problems in practical applications. Author

**N66-13983#** Emmanuel Coll., Boston, Mass. Research Language Center.
**A DYNAMIC MODEL FOR THE NUMERICAL PREDICTION OF BAROCLINIC FLOWS**
Tseng-Hao Chin Bedford, Mass., AFCRL, Aug. 1965 29 p refs Transl. into ENGLISH from Wu Li Hsueh'pao (Peking), v. 33, no. 2, 1963 p 131–144
(Contract AF 19(628)-3869)
(EMM-65-23; AD-623117) CFSTI: HC $2.00/MF $0.50

Some authors have shown that in China, the contribution to the height tendency of an isobaric surface due to surface friction is of the same order of magnitude as that of large scale topographic influences, and that under certain special weather conditions, non-adiabatic heating must be taken into account, even in short-range forecasting. Considering these effects, this paper first derives a two-parameter baroclinic model suitable for numerical weather prediction by combining the hydrodynamic and thermodynamic equations and then solves the system of prognostic equations. The truncation errors in numerical weather prediction when a triangular grid-point system is used are discussed, and an optimum formula for the field is derived. Finally, the paper discusses briefly the problem concerning the development of large-scale baroclinic disturbances. Author (TAB)

**N66-13989#** Emmanuel Coll., Boston, Mass. Research Language Center.
**EVOLUTION OF INDIVIDUAL CUMULUS**
Jui-Yung Chen Bedford, Mass., AFCRL, Aug. 1965 30 p refs
(Contract AF 19(628)-5073)
(EMM-65-1; AD-623110) CFSTI: HC $2.00/MF $0.50

In this paper, the evolution of individual cumulus is studied with basic equations involving the drag effect of water droplets and the phase transformation of moisture (including evaporation caused by entrainment). Considering individual cumulus as a uniform cloud parcel, calculations are made for the thermal conditions and other properties in the evolution process. It is shown that the drag and phase transformation effects on cloud development are important. The results are discussed and compared with observations made in China, and fair agreement is found in many aspects. Author (TAB)

**N66-14134*#** Israel Program for Scientific Translations, Ltd., Jerusalem.
**THE AIR ENVELOPE OF THE EARTH**
Kh. P. Pogosyan 1965 238 p refs Transl. into ENGLISH of the book "Vozdushnaya Obolochka Zemli" Leningrad, Gidrometeorol. Izd., 1962
(NASA-TT-F-287; TT-65-50113) CFSTI: HC $6.00/MF $1.50 CSCL 04A

Our knowledge of the atmosphere has broadened considerably in recent years. This book gives new information on the structure and composition of the atmosphere, the inflow of solar energy and the formation of temperature at various heights, and the motion of the air—the circulation of the atmosphere. Some chapters deal with such interesting phenomena as atmospheric fronts, jet streams and powerful vortexes—cyclones and anticyclones—giving rise to sharp weather variations. The reader is introduced to modern weather forecasting and to the various possibilities of artificially influencing atmospheric processes in order to modify the weather. There is a special chapter dealing with moisture circulation in the atmosphere, moisture rotation on land, and the distribution of precipitation over the globe. A number of chapters contain data on the temperature at the surface and above the earth that were obtained from observations made during the last three to five years, as well as data on changes in climate. The book is intended for a wide circle of readers. Author

**N66-14220#** Aerometric Research, Inc., Goleta, Calif.
**RELATIONSHIPS BETWEEN TIROS CLOUD PATTERNS AND AIR MASS (WIND AND THERMAL) STRUCTURE Final Report**
Robert D. Elliott and John R. Thompson Sep. 1965 61 p ref (Contract N189(188)-58870A)
(NWRF-33-0965-10; AD-622396) CFSTI: HC $3.00/MF $0.75

In recent years considerable effort has been expended in relating Tiros cloud patterns to synoptic analyses with certain worthwhile results. However, little effort has been made to relate the cloud patterns directly to the air mass structure and associated physical processes. This study has been aimed at relating the cloud patterns to wind at various levels, wind shear, thermal advection, vertical differences therein, and air mass stability. Over 300 ship or shoreline radiosonde observations were used in conjunction with nearly simultaneous Tiros photographs to develop statistical summaries of these parameters and their relationship to cloud patterns. Models of the synoptic climatology of Tiros cloud patterns for a generalized cyclonic system are presented which relate the above parameters to the cloud patterns in a way that is consistent with the various physical processes that generate and spread cloud. Statistical tables are provided relating air mass parameters to specific cloud forms. These tables present the information in a variety of forms useful to the forecaster. Author (TAB)

**N66-14302#** Emmanuel Coll., Boston, Mass. Research Language Center.
**FORMATION AND DESTRUCTION OF THERMAL WIND IN A SIMPLE BAROCLINIC ATMOSPHERE**
Chu-Shih Chen Aug. 1965 54 p refs Transl. into ENGLISH from Chin Shu Hueh Pao (Peking), v. 33, no. 1 and 2, 1963 p 51–63; 153–162
(Contract AF 19(628)-3869)
(EMM-65-22; AD-623116) CFSTI: HC $3.00/MF $0.50

This paper discusses the principle of vertical motion variations in the adaptation process of a thermal wind, using a simple two-layer baroclinic model. When the thermal wind vorticity in the wind field is larger than that in the temperature field, the ascending motion accelerates; otherwise, the descending motion accelerates. For the baroclinic system in the upper troposphere between 250 and 750 mb, the temperature field is adapted toward the wind field when the scale of the system is smaller than the critical scale $L_0$, and vice versa when the scale is larger than $L_0$. This is demonstrated by examples computed according to two horizontal scales, 1000 and 300 km, respectively. In the former scale, the adaptation is mainly toward the temperature field, and in the latter, toward the wind field. According to the contrast between the rates of formation and destruction of a thermal wind, the physical process of the formation of geostrophic and ageostrophic motions is described. Finally, the proposed method is applied to examine the baroclinic instability of long waves and then to clarify the vorticity mechanism of the baroclinic instability. Author (TAB)

# 21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

No abstracts in this issue.

# 22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

**N66-13392#** United Kingdom Atomic Energy Authority, Risley (England).
**SOME STUDIES OF NOISE IN THE DOUNREAY FAST REACTOR**
D. C. Menzies and P. G. Bentley 1965 27 p refs
(TRG-715(D)) HMSO: 3s9d

The results are presented of an analysis of some recordings of fluctuations in the readings of several D.F.R. instruments. A short discussion of the theory involved in the analysis is included. Signals from several thermocouples and from an ion chamber were recorded with the reactor operating at 27 MW and full coolant flow. Several interesting features appear in the analysis, the principal results being: (a) There appears to be a resonance in the reactor flux noise spectrum at about 6 cycles/sec. (b) The analysis indicates a small positive temperature coefficient between the particular thermocouple measuring plenum inlet temperature and reactor power. (c) There appears to be a very large amount of low-frequency noise in all the signals. Some aspects of the transfer functions between different reactor instruments and an explanation for some of the results, in particular for the resonance at 6 cycles/sec are included. Author

**N66-13427#** Atomic Energy of Canada Ltd., Chalk River, Ontario.
**THE DESIGN AND PERFORMANCE OF A PROPOSED ION CHAMBER ARRANGEMENT TO MONITOR THE NEUTRON FLUX OF THE NRU REACTOR**

W. J. Henderson, P. R. Tunnicliffe, and A. G. Ward Jul. 1964 8 p
(AECL-2037; RDP-53) CFSTI: HC $1.00/MF $0.50

Some measurements have been made to test the proposed ion chamber arrangement for monitoring the neutron flux of the NRU reactor. This arrangement provides for (a) a simple method of attenuating the neutron flux to the desired level and providing some adjustment, (b) ensuring that the contribution to chamber current during shut-down by gamma radiation from the reactor is negligible, (c) a location for many ion chambers in a relatively small space. The sensitivity of the arrangement has been measured with TQT type ion chambers using neutrons from the NRX thermal column. $2.5 \times 10^{11}$ neutrons/second into the arrangement yields an ion chamber current of one microampere. The expected current in the NRU installation at 200 MW is eight microamperes. Author

**N66-13504#** European Atomic Energy Community, Brussels (Belgium).
**THE USE OF PULSED REACTORS IN THE FIELD OF NEUTRON AND SOLID STATE PHYSICS**
W. Kley 1965 58 p refs Presented at the Symp. "Panel on Kinet. and Appl. of Pulsed Res. Reactors," Vienna, 17–21 May 1965
(EUR-2538.e) CFSTI: HC $3.00/MF $0.50

The neutron source requirements are examined for a particular selection of experiments in the field of neutron and solid state physics. For a number of facilities, the principal design features are given. A quantitative comparison of experiments at a pulsed reactor of the SORA type with those at a very high flux reactor is given. The figure of merit in favour of the SORA type reactor is within the limits of $1 \leq M \leq 40$ for experiments with thermal and subthermal neutrons. In general, the pulsed reactor is better by the flux ratio $M = \Phi SORA / \Phi V.H.F.R.$ for experiments using the time of flight technique. Author

**N66-13510#** California Univ., Livermore. Lawrence Radiation Lab.
**COMPRESSIVE CREEP OF CERAMICS FOR HIGH-TEMPERATURE NUCLEAR REACTORS**
Richard R. Vandervoort and Willis L. Barmore Aug. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-6826, Rev. I) CFSTI: HC $1.00/MF $0.50

Beryllium oxide–uranium oxide mixtures were deformed in compression in the temperature region of 1375 to 1540° C. The apparent activation energy for creep is 95.1 kcal per mole. The creep rate dependence on stress and grain size is consistent with the Nabarro-Herring model. Creep behavior of the oxide mixtures for additions up to 10 wt % urania is ascribed to the deformation of the beryllium oxide matrix. Author (NSA)

**N66-13540*** Atomic Energy Commission, Washington, D. C.
**NUCLEAR SPACE PROGRAM: ORGANIZATION AND PLANS**
Harold P. Finger 17 Nov. 1965 40 p Presented at the Atomic Ind. 12th Ann. Conf., Washington, D. C., 17 Nov. 1965

Major points that define the organization for space nuclear systems developments are discussed. An outline of the operating philosophy of that organization is given, together with improvements that are being made, and improvements still required. The current state of these technical program areas is described and some plans for the immediate future are presented. G.G.

**N66-13550#** Pratt and Whitney Aircraft, Middletown, Conn.
**POTENTIAL LIQUID METAL BEARING MATERIALS FOR SNAP-50/SPUR PUMPS Summary Report**
M. J. Wallace Nov. 1965 70 p refs
(Contract AT(30-1)-2789)
(PWAC-468)

The compatibility and wear characteristics of selected bearing materials, including surface treatments and cemented refractory carbides were investigated in support of the SNAP-50/SPUR pump development program for lithium and NaK systems. Compatibility of candidate materials with 1100F lithium in Cb-1 Zr alloy was studied in tilting capsule tests for durations to 7000 hours. The wear behavior of material combinations was evaluated with a rotating disk-static shoe assembly in lithium and NaK to 1000F. The best compatibility and wear characteristics were exhibited by high density molybdenum cemented carbides. Carburized Cb-1 Zr alloy wear resistance was inconsistent but, under the best conditions, was nearly equivalent to that of the cemented carbides. Plasma-jet sprayed coatings of tungsten carbide and WC-Co gave encouraging results in NaK, but additional development of the coating process appeared necessary, to assure reliable control of adhesion and performance. Based on the results of these tests, carburized Cb-1 Zr alloy and Kennametal K-7178 cermet were recommended as the materials for use in fabricating full size bearings to be tested at SNAP-50/SPUR pump bearing conditions. Author

**N66-13583#** Army Electronics Labs., Fort Monmouth, N. J.
**PULSED NUCLEAR RADIATION INDUCED TRANSIENTS IN ELECTRICAL CABLES (DRF NO. 1)**
William Schlosser, Joseph Newberg, and Joseph A. Key Jul. 1964 36 p refs
(ECOM-2415; AD-623018) CFSTI: HC $2.00/MF $0.50

The pulse nuclear radiation induced transients in the individual conductors of RG-62A/U and RG-59B/U coaxial cables and a multiconductor ribbon cable due to exposure to the DRF-Mark F TRIGA reactor were studied as a function of applied voltage and repetitive exposure. The cable response consists of three current constituents: a replacement current, a conduction current, and a charging current. The predominance of the replacement component over the conduction component of the observed current after repetitive exposure was noted. The charging current is attributed to the introduction of charges in an initial exposure and to the redistribution of charges in an exposure accompanying an applied voltage change. The magnitudes of the induced currents were considerably lower than those observed for these cables at SPRF. An RF signal transmitted through an RG-62A/U cable was attenuated by an amount that was also considerably lower than the attenuation observed at SPRF. Author (TAB)

**N66-13607#** Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.
**ESH-4 TEST PROGRAM: REPORT ON FUEL ELEMENTS IRRADIATED IN THE E-SADE LOOP OF THE VALLECITOS BOILING WATER REACTOR**
E. A. Wick and D. A. Patterson comp. 1 Oct. 1965 120 p refs
(Contract AT(11-1)-1123)
(ACNP-65006) CFSTI: $4.00

Nine superheater elements, each containing seven low enriched $UO_2$ fuel rods were irradiated in the E-SADE loop of the Vallecitos Boiling Water Reactor (VBWR). The ESH-4 test program was designed to demonstrate the capability of low enrichment seven-pin cluster fuel elements to operate satisfactorily as superheater fuel assemblies. It was shown, that the design concepts are sound, and that the fabrication techniques and procedures were satisfactory. The ESH-4 fuel

elements were irradiated in the VBWR for approximately two weeks. This was sufficient time to prove the stability of the seven-pin element in superheater steam, and give preliminary data on operating characteristics. R.W.H.

**N66-13910#** Oak Ridge National Lab., Tenn.
**IRRADIATION EVALUATION OF FUEL ELEMENTS FOR THE PBRE AND AVR REACTORS**
J. L. Scott, J. G. Morgan, and V. A. De Carlo [1964] 5 p refs Presented at 1965 Winter Meeting of the Am. Nucl. Soc., Washington, 15–18 Nov. 1965
(Contract W-7405-ENG-26)
(ORNL-P-1507; CONF-651101-20) CFSTI: HC $1.00/MF $0.50

Results are summarized of an irradiation test program carried out on spherical fueled-graphite elements containing pyrolytic carbon-coated fuel microspheres. The elements had either machined-graphite shells, molded-unfueled shells, or no shells. Maximum burnups were 9 and 27 at. % for the 6.0- and 3.8-cm-dia spheres, respectively. Good irradiation stabilities were obtained; duplex and triplex, but not laminar, coatings on the fuel particles survived the maximum burnups. Fission gas releases, thermal conductivity, and shrinkages are discussed briefly. Author (NSA)

**N66-13927#** Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
**PULSED REACTORS AND PULSED CRITICAL ASSEMBLIES A Literature Search**
Richard J. Smith comp. Nov. 1965 51 p refs
(TID-3571(Suppl. 1)) CFSTI: $3.00

A total of 246 subject-arranged annotated references is presented to reports, published literature, and patents concerning the technology of pulsed neutron facilities. Personal author and report number-availability indexes are provided. Author

**N66-13929*#** General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
**PRECRITICAL CALCULATIONS FOR THE 3.0 IN. PITCH, BERYLLIUM REFLECTED, TWMR CRITICAL ASSEMBLY**
J. C. Peak and J. M. Lovallo 8 Nov. 1965 19 p refs
(Contract SNPC-27)
(NASA-CR-54786; GA-6807) CFSTI: HC $1.00/MF $0.50

The feasibility of an isotopically enriched tungsten, water moderated reactor for use as a nuclear rocket was determined. Accurate and detailed information from reactor analysis and basic critical experiments for the corroboration of the calculated nuclear characteristics of the reactor concept was generated. It was noted that the third of a series of critical assemblies were fabricated and the necessary precritical neutronic calculations were performed. The critical loadings are presented and the precritical calculations are summarized for the 3.0 in. pitch core with beryllium reflectors. R.W.H.

**N66-13930#** Battelle Memorial Inst., Columbus, Ohio
**PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER, 1965**
Russell W. Dayton and Stan J. Paprocki 1 Nov. 1965 31 p
(Contract W-7405-ENG-92)
(BMI-1748) Available from AEC, Oak Ridge, Tenn.: $0.75

Progress is reported in the following areas: reactor materials and components, fuel studies, uranium-plutonium mononitride fuel materials, radioisotope and radiation applications, coated-particle fuel materials, and corrosion studies of the fluidized bed fluoride volatility process. These areas include such research as the effect of irradiation on the mechanical properties of stainless steel, the densification of graphite by unconventional fabrication techniques, the development of $BeO$-$ThO_2$-$PuO_2$-$PuO_2$ fuels, measurements of physical properties of nitride fuels, radiation induced formation of organometallic compounds, and carbon coated uranium nitride compatibility studies. C.T.C.

**N66-13936#** Sandia Corp., Albuquerque, N. Mex.
**RFD-2 TELEMETRY SYSTEM**
L. J. Keck Jul. 1965 96 p
(Contract AT(29-1)-789)
(SC-DR-65-205) CFSTI: HC $3.00/MF $0.75

The description of the design and performance of the telemetry system flown on Re-entry Flight Demonstration No. 2, which was the second in Sandia's series of operational safety flight tests of systems for nuclear auxiliary power is presented. Author (NSA)

**N66-13961#** Battelle Memorial Inst., Columbus, Ohio.
**FISSION-FRAGMENT EFFECTS IN STRUCTURAL MATERIALS Quarterly Progress Report, Apr.–Jun. 1965**
Robert L. Ritzman, Neal M. Griesenauer, and Edward J. Jablonowski 1 Jul. 1965 11 p refs
(Contract W-7405-ENG-92)
(BMI-X-10134)

Progress is reported on the determination of the type and magnitude of mechanical-property changes produced in annealed AISI 304 stainless steel and annealed Zircaloy-2 by fission-fragment irradiations. Stress-strain data calculated from bend tests of annealed Type 304 stainless steel indicated a nominal 0.2% offset yield strength of 28,900 psi for nonirradiated material, 30 550 psi for material irradiated to a fast-neutron exposure of $9.2 \times 10^{16}$ nvt, and 34 100 psi for material neutron irradiated and recoil impregnated to an exposure of $2.1 \times 10^{14}$ fission fragments/cm$^2$. Volumetric expansion coefficients of both Zircaloy-2 and stainless steel were calculated and compared for exposure of $7.1 \times 10^{14}$ and $6.1 \times 10^{15}$ fission fragments/cm$^2$. Strain effects were found to be more pronounced in Zircaloy-2 than in the stainless steel. E.E.B.

**N66-14042#** European Atomic Energy Community, Brussels (Belgium).
**TRANSFER FUNCTIONS ANALYSER FOR DRAGON REACTOR [ANALYSEUR DE FONCTIONS DE TRANSFERT POUR LE REACTEUR DRAGON]**
I. Bredael and F. Sciuto 1965 62 p In FRENCH; ENGLISH summary
(EUR-2431.f) CFSTI: HC $3.00/MF $0.75

The description of a transfer functions analyzer is given. The interest of this realization resides in the measurement accuracy and in the flexibility on use. The equipment, completely transistorized, is based on digital techniques. Author (NSA)

**N66-14062*#** Aerojet-General Corp., Azusa, Calif.
**SNAP-8 MATERIALS REPORT FOR JANUARY–JUNE 1964. VOLUME I: ELECTRICAL INSULATION DEVELOPMENT**
R. P. Dillingham Jul. 1964 51 p refs *Its* Rept.-2880, Vol. I
(Contract NAS5-417)
(NASA-CR-54716) CFSTI: HC $3.00/MF $0.50 CSCL 18N

The objectives of the SNAP-8 Electrical Insulation Development Program are (a) to select, test, and evaluate insulating materials and systems that are applicable to the various SNAP-8

electrical components; (b) to fabricate inorganic insulation systems for the heat-rejection-loop (HRL) and primary-loop NaK motors; and (c) to coordinate Aerojet-General subcontractor activities in the area of electrical insulation. The emphasis during the first and second quarters of 1964 was on application of previously engineered systems to hardware units and on necessary modifications revealed by construction. Some long-term testing was continued, and some material screening for the radiation-effects program was completed. The period was further characterized by completion of the first inorganic-insulated stator and the arrival and acceptance of Aerojet-designed terminal insulators for the pump-motor assemblies (PMAs). In addition to the reported work, advice and laboratory aid were rendered in many areas not specifically covered by the insulation program, such as leak-detection methods for the turbine-alternator assembly, repair of the mercury-pump motor, and installation of rotor cans on the NaK PMA rotors. Author

**N66-14063*#** Aerojet-General Corp., Azusa, Calif.
**SNAP-8 MATERIALS REPORT FOR JANUARY–JUNE 1964. VOLUME II: DEVELOPMENT OF COMPONENT MATERIALS**
H. Derow and B. E. Farwell Jul. 1964 68 p refs *Its* Rept.-2880, Vol. II
(Contract NAS5-417)
(NASA-CR-54717) CFSTI: HC $3.00/MF $0.75 CSCL 18N

Work was performed with the aim of providing data to guide the selection of materials for SNAP-8 system components, and providing metallurgical assistance in the design, development, fabrication, and testing of that system. Areas investigated were: system fluids; boiler materials and fabrication; condenser tube-to-tube sheet joint; turbine rotor and nozzle materials; and mercury corrosion loop. R.W.H.

**N66-14065*#** Lockheed Nuclear Products, Marietta, Ga.
**EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES**
C. A. Schwanbeck Nov. 1965 81 p refs
(Contract NAS3-7985)
(NASA-CR-54787; LAC-ER-8231) CFSTI: HC $3.00/MF $0.75 CSCL 18F

The scope of the test program is divided into two general phases, tensile testing and low-cycle fatigue testing. The tensile testing phase will utilize existing test loops and includes a study of the effects of irradiation at 30° R to $10^{18}$ nvt, a study of the effects of irradiation temperature, and a study of the effects of self-annealing following irradiation. The low-cycle fatigue testing phase requires extensive modification of existing test loops and the hydraulic load control system and includes both fatigue testing during irradiation at 30° R and fatigue testing following irradiation at 30° R to $10^{17}$ nvt. Author

**N66-14072#** Battelle-Northwest, Richland, Wash.
**PHYSICS RESEARCH QUARTERLY REPORT, APRIL, MAY, JUNE 1965**
J. H. Lauby et al 15 Jul. 1965 74 p refs
(Contract AT(45-1)-1830)
(BNWL-49) CFSTI: $3.00

Research is reported in the following areas: (1) *Light Moderator Reactor Physics*—summary of water moderated experiments with Pu–Al fuel, the $PuO_2$–$UO_2$ experiment, high temperature lattice test reactor driver fuel design analysis; (2) *Engineering Physics*—theoretical and experimental resonance absorption in $Pu^{240}$, physics analysis of a U–Al polyethylene system; (3) *High Temperature Reactor Physics*—spherical and slab geometry solutions to a two-region boundary value problem giving temperature increase during an exponential power rise, neutron pulsing possibilities; (4) *Heavy Moderator Reactor Physics*—Pu–Al polyethylene experiments; and (5) *Critical Mass Physics*—foil activation studies, Monte Carlo calculated values of $Pu^{238}$ as a function of hydrogen to fuel atomic ratios and $Pu^{239}$ enrichment, and resonance absorber admixed in the moderator of heterogeneous arrays. R.W.H.

**N66-14080#** Commissariat a l'Energie Atomique, Cadarache (France). Departement de Recherche Physique.
**PRELIMINARY STUDIES LEADING TO A CONCEPTUAL DESIGN OF A 1000 MWe FAST NEUTRON REACTOR [ETUDES PRELIMINAIRES CONDUISANT A UN CONCEPT DE REACTEUR A NEUTRONS RAPIDES DE 1000 MWe]**
G. Vendryes, C. P. Zaleski, R. Abdon, A Chalot, P. Clauzon et al Brussels, EURATOM, Sep. 1965 200 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-006-61-10 RAAF)
(CEA-R-2554; EUR-2235.f) CFSTI: HC $5.00/MF $1.25

This report presents the results of studies which seemed important to undertake in connection with the development of fast neutron reactors. It points out the advantage of high internal breeding ratios which are necessary in order to get a small change in time both in power distribution and reactivity. It shows how to achieve this goal, when simultaneously power distribution flattening is obtained; this results in a higher mean specific power (which is an economic gain) and therefore in a small doubling time (about 10 years). It attempts to find criteria concerning the specific power that should be used in future reactor designs. It presents a conceptual design of a 1000 MWe fast neutron reactor for the realization of which no technological impossibility appears. It shows that the dynamic behaviour seems satisfactory, despite a positive total isothermal sodium coefficient. It tries to predict the development of fast reactors within the future nuclear program. It does not appear that fissile materials' supply problems would, in France, slow down the development of fast neutron reactors, which will be essentially tied to France's economical ability to produce cheap electric power. Author

**N66-14094#** Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
**AN ANALYSIS OF SOME TWO-ZONE EXPONENTIAL EXPONENTIAL EXPERIMENTS ON GRAPHITE MODERATED LATTICES**
D. C. King and M. Gibson Jul. 1965 28 p refs
(AEEW-R-428) HMSO: 4s

In this paper two methods for deriving the buckling of the test lattice from two-zone heterogeneous graphite exponential experiments are demonstrated. These are based on (a) one group perturbation theory and (b) two-group diffusion theory. It is shown that, although the two group method has wider applicability, both methods are sufficiently accurate when the lattice parameters are matched within certain limits. With sufficient test fuel available to load one half of the stack the analysis error is small compared with full stack systematic experimental uncertainties and an accuracy of ±0.35% in reactivity is possible for A.G.R. type lattices. Author

**N66-14137#** European Space Vehicle Launcher Development Organization, Paris (France).
**SEVERAL CONSIDERATIONS OF ECONOMIC ASPECTS OF THE UTILIZATION OF RADIO-ISOTOPE GENERATORS IN SPACE [QUELQUES CONSIDERATIONS SUR LES ASPECTS ECONOMIQUES DE L'UTILISATION DES GENERATEURS RADIO-ISOTOPIQUES DANS L'ESPACE]**

J. P. Contzen Oct. 1965 13 p In FRENCH
(ELDO-TM-F-18, Rev.; FP2/ENEA-24; SEN/IPSA(65)29) CFSTI: HC $1.00/MF $0.50

A calculation method is given for determining the specific investment, i. e., cost per unit power, of various space electrical power systems. Radioisotope systems are of particular concern. Factors include construction and operating costs, and cost per unit weight in launching. These are weighed against power output, reliability, length of operating life, and mission requirements. In addition to radioisotope systems, fuel cells, fuel generators, and solar batteries are discussed. Transl. by D.T.

**N66-14263#** European Atomic Energy Community, Brussels (Belgium).
**KINETIC THEORY AND CALCULATIONS FOR AN ACCELERATOR BOOSTER WITH PERIODICALLY VARYING MULTIPLICATION FACTOR**
R. Misenta Aug. 1965 44 p refs
(EUR-2492.e) CFSTI: HC $2.00/MF $0.50

The relation for the mean power of a system periodically pulsed reactor and accelerator has been derived using the multiplication factor X for the mean power of a periodically pulsed reactor. The relation shows that the power produced in the reactor by the accelerator pulse is multiplied by a factor $1/(1-\chi)$, due to the presence of the delayed neutron emitters. In analogy to normal reactors the operation of a periodically pulsed reactor in connection with an accelerator is called pulsed subcritical. The pulsed subcritical mode of operation offers the possibility to shape the resulting pulse according to the requirements of the experiments by varying the maximum value of the effective multiplication factor $\kappa$ or the point of time for the injection of the accelerator pulse. For an assumed accelerator source strength of $10^{17}$ n/sec pulse characteristics as function of the mean power density of the reactor are calculated for two cases which differ by the maximum value of the effective multiplication factor. Author

**N66-14286*#** United Aircraft Corp., East Hartford, Conn. Research Labs.
**ANALYTICAL STUDY OF HYDROGEN TURBOPUMP CYCLES FOR ADVANCED NUCLEAR ROCKETS Progress Report, Sep. 15, 1964–Sep. 15, 1965**
G. H. Mc Lafferty, H. H. Michels, T. S. Latham, and R. Roback Sep. 1965 80 p refs
(Contract NASw-847)
(NASA-CR-68988; D-910093-19) CFSTI: HC $3.00/MF $0.75

An analytical study was conducted to determine the characteristics of three different turbopump cycles which might be employed to obtain the high engine inlet pressures which are expected to exist in advanced nuclear rockets. The three cycles considered were: a topping cycle, in which the power required to drive the pump is obtained by passing all of the pump-exit flow through a turbine before this flow enters the engine; a bleed cycle, in which all of the pump power is obtained by discharging a fraction of the pump-exit flow through a bleed turbine with an expansion pressure ratio of 0.01; and a mixed cycle, in which half of the power to drive the pump is obtained from a primary turbine and half from a bleed turbine. The results of the study indicate the effect of engine inlet pressure on the turbine pressure drop and/or the bleed flow fraction for each cycle. Three studies not connected with hydrogen turbopumps are described. These are: an analysis of the approximate temperature distribution in the fuel-containment region of a coaxial-flow gaseous nuclear rocket; a change in form of heavy-gas containment data; and an analysis of the heat generation rate in fuel passing through a fuel injection duct located in the moderator of a gaseous nuclear rocket engine. Author

# 23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

23

**N66-13326** Joint Publications Research Service, Washington, D. C.
**ON THE STABILITY OF MECHANICAL SYSTEMS WITH MANY DEGREES OF FREEDOM USING A CORRECTION DEVICE**
I. M. Sidorov and I. P. Korotayeva *In its* News of the Acad. of Sci. USSR Dept. of Tech. Sci. 30 Nov. 1965 p 267–274 *ref*
(See N66-13301 04-10) CFSTI: $6.00

Mechanical systems which develop control forces and have error correcting devices are considered, and a procedure is proposed for the construction of the regions of structural stability and instability in the dimensionless parameters of the control object. Criteria for structural stability are discussed, the stability of the mechanical system is investigated, and characteristic equations for the system are evolved. The case of two pendulums is considered, and it is shown that regions of instability are located in both pendulums. M.W.R.

**N66-13424#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**INVESTIGATION OF THE TRAJECTORIES OF LOW-THRUST MATERIAL POINT MOTION ON AN ANALOG COMPUTER**
Iu. A. Klikh and A. F. Makarov 16 Jun. 1964 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 8, 1965 p 1016–1019

The motion of a point with low constant thrust in a central force field was analyzed. The Krylov–Bogoliubov method was used to obtain approximations of the nonlinear differential motion equations, and subsequent simulation of the problem on an analog computer obtained the trajectory of the considered motion. G.G.

**N66-13442#** Israel Program for Scientific Translations, Ltd., Jerusalem.
**MEASUREMENT ERRORS AND EMPIRICAL RELATIONS**
M. A. Velikanov 1965 139 p refs Transl. into ENGLISH of the book "Oshibki Izmereniya i Empiricheskie Zavisimosti" Leningrad, Gidrometerol. Izd., 1962
(TT-65-50008) CFSTI: $6.00

This book combines in a single aspect the analysis of errors in the measurement of quantities and of the methods for deriving approximate dependencies; and, without infringing on the methods of the classical theory of errors, goes beyond the limits of classical theory, especially when the deviations are not symmetrically distributed, as postulated in that theory. Discussions are included on basic probability concepts, one-dimensional populations of random variables, distribution of discrete and continuous random variables, errors in measurements, measurement of large and small quantities, dependence between measured quantities, deduction of the form of dependence between two measured quantities, search for the form of dependence between three measured quantities, dimensional method, logarithmic anamorphosis, and basic forms of empirical curves. R.N.A.

**N66-13465#** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate.
**ATMOSPHERIC SOUND PROPAGATION NEAR THE EARTH'S SURFACE**
Ricardo Pena and Marvin Diamond Oct. 1965 13 p
(ECOM-5018; AD-473746)

A study of sound propagation near the earth's surface under relatively calm meteorological conditions showed considerable variation in the pressure of detected waves. This variation was shown to be due to atmospheric effects between the source and detector. The accuracy of determining the elevation angle of the sound source was found to be highly dependent upon the surface temperature. Author (TAB)

**N66-13487#** Itek Corp., Lexington, Mass.
**STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 13, 15 Jul.–15 Oct. 1965**
[1965] 83 p refs
(Contract AF 33(657)-9158)
(ITEK-65-9048-14; AD-473799)

The current aim of this program is to provide valid computational means for the determination of object-image relationships in the lens-film portion of the photoreconnaissance system. Toward this end, the maximum practical use is being made of Fourier analysis techniques. To implement the use of the Fourier techniques, we have prepared a computer program which provides the means for efficiently carrying out the necessary transformation between the spatial and frequency domains. To provide the necessary computational methods and inputs and to test their validity, we are conducting experimental and theoretical studies of the response of lenses, emulsions, and lens-emulsion combinations. Author (TAB)

**N66-13521#** Argonne National Lab., Ill.
**SOME TOPICS IN STATISTICAL MECHANICS Series of Lectures, 1964–1965**
B. R. A. Nijboer Jun. 1965 67 p refs
(Contract W-31-109-ENG-38)
(ANL-7063) CFSTI: $3.00

Several topics in statistical mechanics are discussed including ensembles and the Liouville theorem, molecular distribution functions, some properties of the pair distribution function, the one-dimensional system, and the Mayer cluster expansions. R.N.A.

**N66-13526#** Institut Franco-Allemand de Recherches, St. Louis (France).
**FRICTIONAL DRAG OF A CONE OF REVOLUTION AT A ZERO ANGLE OF ATTACK IN A SUPERSONIC FLOW RELATIONSHIP WITH THE CYLINDER [TRAINEE DE FROTTEMENT D'UN CONE DE REVOLUTION SOUS INCIDENCE NULLE DANS UN ECOULEMENT SUPERSONIQUE. ANALOGIE AVEC LE CYLINDRE]**
J. Luneau 26 Feb. 1963 12 p refs In FRENCH
(ISL-T-3/63) CFSTI: HC $1.00/MF $0.50

This study shows how the calculation for the frictional drag of a cone of revolution, at zero angle of attack in a supersonic flow, can be applied to the calculation for a cylinder under the same conditions. Both laminar and turbulent flow situations are examined, and a simple relation is established among the respective parameters of the cylinder and cone. The relations are only valid for low supersonic speeds and slender cones. Evidence is given for a corrective term which is to be calculated for opposing cases. Transl. by D.T.

**N66-13537#** Institut Franco-Allemand de Recherches, St. Louis (France).
**MEASUREMENT OF LIGHT OF WEAK SHOCK WAVES PART IIB [LICHTMESSUNGEN AN SCHWACHEN STOSSWELLEN TEIL IIB]**
A. Mach and F. Roessler 15 Nov. 1963 21 p refs In GERMAN
(ISL-T-22/63) CFSTI: HC $1.00/MF $0.50

Luminescent phenomena following a helium shock wave traveling through the argon atmosphere of a narrow tunnel were studied by time-expansion photography. The observed delayed traveling time of the luminescence behind the shock wave was explained by the turbulence that developed through gas vaporization and particle reflection from the tunnel walls, thus causing a velocity decrease in the boundary layer zone. Spectral analyses of the luminescence confirmed the presence of impurity particles from the tunnel material. Transl. by G.G.

**N66-13538#** Institut Franco-Allemand de Recherches, St. Louis (France).
**ELECTRONIC MICROSCOPE STUDY OF THE FORMATION OF LATTICE IN COPPER OXIDE CRYSTALS AND THEIR UTILIZATION AS SUSPENDED CAPTOR PARTICLES [ELEKTRONENMIKROSKOPISCHE UNTERSUCHUNG UBER DIE BILDUNG VON GITTERN AUS KUPFEROXID-NADELKRISTALLEN UND UBER IHRE EIGNUNG ALS SCHWEBSTOFFANGER]**
R. Nagel and H. W. Koch 25 Oct. 1963 27 p refs In GERMAN
(ISL-T-23/63) CFSTI: HC $2.00/MF $0.50

Copper oxide whiskers formed through oxidation of fine copper screens in a moist oxygen flow at temperatures of 400° to 430° C; were studied by electron microscope for their ability to absorb particles from various aerosol streams, as well as dust from the air. Adsorption of droplets and particles in a wind tunnel and under shock wave conditions established the good elasticity of the obtained copper whisker lattice. Caught droplets formed into spheres on the whiskers' surfaces; solid dust particles, regardless of size, clung to the contact area of the whiskers with good adhesion. Some correlation between the particle size distribution on the whisker lattice and the aerosol distribution in the air stream was found.
Transl. by G.G.

**N66-13551*#** Wisconsin Univ., Madison. Theoretical Chemistry Inst.
**PATH-INTEGRALS IN DYNAMICS**
A. M. Arthurs 1 Nov. 1965 19 p refs
(Grant NsG-275-62; Contract DA-11-022-ORD-2059)
(NASA-CR-68737; WIS-TCI-132) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The Lagrangian formulation of quantum dynamics in terms of path-integrals due to Feynman describes systems for which the Hamiltonian is classical in form and quantization is carried out in terms of commutators rather than anticommutators. The difficulty with the Feynman method is the actual evaluation of the path-integral itself. We give an explicit evaluation for classical wave motion in one dimension. This requires an extension of the Feynman method which was introduced by Tobocman and studied in detail by Davies. We also discuss the work of Corson on the question of a unified formulation of dynamics.
Author

**N66-13584#** Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
**A DISCUSSION OF THE WHEELER-FEYNMAN ABSORBER THEORY OF RADIATION**

Ronald G. Newburgh Oct. 1965 25 p refs *Its* Phys. Sci. Res. Papers No. 154
(AFCRL-65-752; AD-623648) CFSTI: HC $2.00/MF $0.50

The Wheeler-Feynman absorber theory of radiation is reviewed. A proof is offered to show that a sum of advanced and retarded effects from the absorber can provide the origin of radiative reaction. This proof is different from and perhaps simpler than that of Wheeler and Feynman. From arguments of momentum and energy conservation the necessity of the absorber for the emission of radiation is demonstrated for three cases. Author (TAB)

N66-13593# California Univ., Berkeley. Lawrence Radiation Lab.
**KINETICS OF THE DISSOLUTION AND DIFFUSION OF THE OXIDES OF IRON IN SODIUM DISILICATE GLASS**
Marcus Preston Borom (Ph.D. Thesis) 4 Aug. 1965 54 p refs
(Contract W-7405-ENG-48)
(UCRL-16232) CFSTI: HC $3.00/MF $0.50

The dissolution of the three oxides of iron by sodium disilicate glass was studied in the temperature range 900 to 1100° C. Diffusion anneals were conducted at several times for each temperature, and the concentration distributions in the iron oxide–glass diffusion couples were analyzed by means of an electron microprobe. The variation of the concentration profiles with time established that the dissolution is controlled by diffusion in the molten glass. The diffusion kinetics were determined by two methods, which employed in one case the mathematics for ternary diffusion. The application of the mathematics for binary diffusion permitted only the determination of an apparent diffusivity for the oxides of iron; however, the mathematics of ternary diffusion yielded information regarding the self-diffusion coefficients of each of the individual cations. The relation between the diffusivities is given by $D_{Na} >> D_{Fe}^{2+} > D_{Si}^{4+} \geq D_{Fe}^{3+}$. The concentration dependence of the diffusion coefficients of the various cations is interpreted on the basis of composition-dependent structural changes in the glass. An activation energy of 30.4 kcal was determined for the diffusion of each of the valences of iron, and the activation energy was found to be independent of glass composition. Author (NSA)

N66-13604*# Tennessee Univ., Knoxville. Dept. of Engineering Mechanics.
**DYNAMICS OF GAS BUBBLES IN AN OSCILLATING PRESSURE FIELD Quarterly Report, Jul.–Sep. 1965**
C. M Remenyik, S. S. Douglass, and F. N. Peebles Oct. 1965 24 p refs
(Contract NAS8-20152)
(NASA-CR-68301; EM-65-10-1) CFSTI: HC $1.00/MF $0.50 CSCL 20D

An exploration was made of the mechanism of bubble formation and the dynamics of bubble behavior in vibrating liquids. Emphasis was placed on the relationships of these phenomena to fluid properties. Experiments are described and tentatively interpreted partly in the light of preliminary theoretical considerations. Examinations of the experimental observations are given, and an attempt is made to correlate and combine them into hypotheses for suggesting analytical methods and new experiments. All experiments were performed with dyed methyl alcohol in a six inch diameter plastic tank having one-half inch thick walls. C.T.C.

N66-13624# Holman (John F.) and Co., Inc., Washington, D. C.
**SCATTERING OF POLARIZED LIGHT BY NEMATIC-TYPE LIQUID CRYSTALS [SUR LA DIFFUSION, PAR LES CRISTAUX LIQUIDES DU TYPE NEMATIQUE, DE LA LUMIERE POLARISEE]**
Pierre Chatelain Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Oct. 1965 25 p refs Transl. into ENGLISH from Acta Cryst. (Copenhagen), v. 1, 1948 p 315–323
(Contract DA-44-009-AMC-930(T))
(ERDL-T-180-65; AD-621937) CFSTI: HC $2.00/MF $0.50

Experiments were made on the scattering of plane polarized sodium light by an oriented preparation of azoxyanisole in the liquid-crystal state at scattering angles, S from 0–50 deg. It was found that the most intense scattered radiation is polarized at right angles to the vibration direction of the incident beam. The variation of the scattered intensity, I, as a function of s is given by $I = K/(\sin s)$ to the mth power, (m = 1, ..., 8) and shows that scattering is due to large particles; a comparison of scattering in forward and backward directions indicates that the dimensions of these particles are of the order of 0.2 microns. The principle of reciprocity is found to apply to the liquid-crystal preparation, as was expected for a medium possessing an axis of revolution. Author (TAB)

N66-13647*# National Bureau of Standards, Washington, D. C. Atomic Physics Div.
**MEASUREMENT OF THE VELOCITY OF LIGHT Annual Report**
[1963] 51 p refs
(NASA Order S-49296(G))
(NASA-CR-68779) CFSTI: HC $3.00/MF $0.50 CSCL 20F

Recent developments in measuring the velocity of light with an accuracy surpassing that of previous measurements by several orders of magnitude are reviewed. The present probable error is about 3 parts in $10^7$. However, techniques are outlined indicating that the velocity of light can be measured with a precision of about 1 part in $10^9$ or better when an interferometer of one to two meters is used. It is shown that the above precision corresponds to limitations inherent in the equipment, while the accuracy of the measurement is limited by the present length standard. R.R.D.

N66-13650*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**[PROGRESS IN GENERAL PHYSICS, PLASMA DYNAMICS, COMMUNICATION SCIENCES, AND ENGINEERING] Quarterly Progress Report No. 79, Period Ending 31 Aug. 1965**
H. J. Zimmarmann and G. G. Harvey 15 Oct. 1965 281 p refs
(Grants NsG-334; NsG-419; NsG-496; Contracts DA-36-039-AMC-03200(E); AF 33(615)-1083 et al)
(NASA-CR-68785) CFSTI: HC $6.00/MF $1.50 CSCL 20

Presented is a review of the research activities of the Laboratory for the three month period covering the following subjects: *Molecular Beams; Microwave Spectroscopy; Radio Astronomy; Optical and Infrared Spectroscopy; Geophysics; Noise in Electron Devices; Physical Electronics and Surface Physics;* and *Physical Acoustics* under the section on *General Physics.* Also, progress in *Plasma Physics; Gaseous Electronics; Plasma Electronics;* and *Plasma Magnetohydrodynamics* and *Energy Conversion* is presented under the section on *Plasma Dynamics.* The section on *Communication Sciences and Engineering* includes reports on *Statistical Communication Theory; Processing and Transmission of Information; Cognitive Information Processing; Communications Biophysics;* and *Computation Research.* E.E.B.

N66-13677# Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.
**LEEWARD DEPOSITION OF PARTICLES ON CYLINDERS FROM MOVING AEROSOLS**

Gabrielle Asset and Thomas G. Hutchins Aug. 1965 30 p refs
(CRDLR-3300; AD-622370) CFSTI: HC $2.00/MF $0.50

A study of leeward (back) deposition of moving aerosols on cylinders was conducted in a wind tunnel. Cylinder sizes were varied from 3.1 to 41 mm in diameter, aerosol particles from 4.5 microns to 110 microns in diameter, and wind velocities from 3 to 18 mph. There was little leeward deposition of particles over 100 microns in diameter, an intermediate amount of deposition of particles between 10 microns and 100 microns in diameter (depending on conditions), and a large deposition of particles below 10 microns in diameter at velocities from 3 to 18 mph. The ratio of leeward and windward particle count deposits on the cylinders was calculated from experimental results. The impaction parameter K and the Reynolds number of the airflow around the cylinder were also calculated. When K was greater than the critical value of 0.0625, the ratio was 0.4% or less, and showed no variation with particle size, cylinder diameter, and wind velocity. When K was less than 0.0625, the ratio ranged from about 0.5% to 131%. In general, the ratio increased with decreasing particle size and wind velocity and with increasing cylinder diameter. Author (TAB)

**N66-13687#** Army Cold Regions Research and Engineering Lab., Hanover, N. H.

**OPTICAL MEASUREMENTS ON SNOW**

Malcolm Mellor Jun. 1965 23 p refs
(CRREL-RR-169; AD-622775) CFSTI: HC $2.00/MF $0.50

Spectral extinction measurements for the visual range were made on homogeneous snow samples prepared under controlled conditions, with snow density and grain size as variables. Comparative measurements were made on coarse-grained natural snow. Extinction coefficient $\upsilon$ was in the range 0.8 to 1.7/cm for fine-grained dense snow, and 0.16 to 0.37/cm for the coarse-grained snow. In the fine-grained snow, where scattering is thought to be the dominant attenuating process, there is a general decline in $\upsilon$ as wavelength $\lambda$ increases from 0.4 to 0.7 microns. In the coarse-grained snow, where absorption becomes significant, spectral selection was slight, with a weak minimum in the region 0.5 to 0.6 microns. When $\upsilon$ is related to density it must have a maximum value; limited data for fine-grained snow show this maximum in the density range 0.45 to 0.60 g/cc, and the density for maximum extinction is inversely related to wavelength. For a given density $\upsilon$ decreases as grain size increases, the rate of change varying with wavelength. Spectral reflectance measurements on natural snow are reported, and attenuation data are interpreted to give surface reflectivity for fine-grained snow. Diffuse reflection from fine-grained snow is believed to have little spectral dependence in the visual range, but with coarse-grained snow reflectance is expected to become inversely dependent on wavelength. It is suggested that optical principles might be applied in the measurement of snow structure, and also for remote sensing of snow-covered terrain. Author (TAB)

**N66-13690#** Pittsburgh Univ., Pa.

**THE RUNGE-LENZ VECTOR AND THE COULOMB GREEN'S FUNCTION**

Levere Hostler [1964] 18 p refs
(Contract Nonr-624(16))
(AD-622230) CFSTI: HC $1.00/MF $0.50

The fact that the Runge-Lenz vector is an extra constant of the motion for a charged particle moving in a Coulomb potential is found to account for the especially simple structure of the nonrelativistic coordinate space Coulomb Green's function. Also, the study of the consequences of this extra constant of the motion leads to a separation of variables in the differential equation for the coordinate space Coulomb Green's function, and hence to a new derivation of the closed form expression for this Green's function which avoids the use of infinite series and the detailed properties of special functions. Author (TAB)

**N66-13699#** Massachusetts Univ., Amherst. Polymer Research Inst.

**THE SCATTERING OF LIGHT BY ANISOTROPIC DISCS WITH THEIR PRINCIPAL POLARIZABILITY DIRECTION AT AN ANGLE TO THE RADIUS**

Richard S. Stein and Stuart B. Clough 30 Jun. 1965 52 p refs
(Contract Nonr-3357(01))
(ONR-TR-76; AD-622579) CFSTI: HC $3.00/MF $0.50

Equations are presented for the scattering of light by two-dimensional polymer spherulites in which the optic axes of the uniaxial crystals are oriented at an arbitrary angle B to the radii. For the case where the axes lie in the plane of the disc, the scattering patterns are identical to those calculated previously for B = 0 degrees, except that they are rotated through the azimuthal angle by the amount B. Of special interest is the case where the crystals rotate helicoidally about the radii (banded spherulites). The equations predict scattering maxima whose position is related to the period of rotation and the angle B. Author (TAB)

**N66-13760#** Allied Research Associates, Inc., Concord, Mass.

**A BONDED POLARISCOPE FOR THREE-DIMENSIONAL PHOTOVISCOELASTIC STUDIES Final Report**

Herbert Becker and Ralph Papirno 10 Dec. 1964 33 p refs
(Contract Nonr-4058(00) FBM)
(ARA-F-226-2; AD-623049) CFSTI: HC $2.00/MF $0.50

A method of incorporating an internally bonded polariscope has been developed for use with viscoelastic materials. The newly developed technique serves to isolate one or more planes in a three-dimensional model so that a three-dimensional photoviscoelastic analysis can be performed. The model may be subjected to a variety of loadings at room temperature and only the photomechanical effects in the isolated plane will be observable. In the experimental program a viscoelastic cement was developed whose mechanical properties matched those of a chosen model material. The cement was used to bond the polarizing sheet into the model. The restraining effect of the stiff elastic Polaroid sheet was reduced by cutting a gridwork of slits into this material. Tests performed on simple disk models and on star grain rocket models containing bonded polariscope elements showed structural continuity through the cemented joint. The fringe pattern observed through the bonded polariscope in star grain models was the same as that observed using a conventional polariscope. On the basis of the favorable test results the newly developed technique was judged acceptable. Author (TAB)

**N66-13761#** Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

**NEARFIELD INFRASONIC NOISE GENERATED BY THREE TURBOJET AIRCRAFT DURING GROUND RUNUP OPERATIONS Final Report, Jun.–Aug. 1964**

Robert T. England and Robert G. Powell Aug. 1965 23 p refs
(AMRL-TR-65-132; AD-623086) CFSTI: HC $1.00/MF $0.50

Acoustic measurements in the frequency range between 4.5 to 4500 cycles per second were made on the near field sound pressure environment produced by the F-101B, NF-102A, and F-106A turbojet aircraft during ground runup operations. Results from twenty eight microphone locations show

that the maximum infrasonic noise below audio frequency range is generated downstream from the exhaust nozzle and at engine settings producing maximum turbulent flow. Author (TAB)

**N66-13765#** Naval Research Lab., Washington, D. C. Applied Optics Branch.
**A BIBLIOGRAPHY OF CERTAIN OPTICAL PROPERTIES OF LIQUID WATER IN THE INFRARED REGION (1–2000 MICRONS) Interim Report**
P. W. Davis Aug. 1965 18 p refs
(NRL-BIBL-25; AD-622225) CFSTI: HC $1.00/MF $0.50

A selective bibliography was compiled of references pertaining to the absorption spectra, reflectance spectra and optical constants of liquid water in the infrared from 1 micron to 2000 microns. Representative curves are presented for absorption, reflectance and index of refraction. There is a serious deficiency in the scientific literature on the infrared optical properties of sea water. Author (TAB)

**N66-13779** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**A GENERALIZED VERSION OF THE NEWTON METHOD FOR THE SOLUTION OF BOUNDARY PROBLEMS**
V. A. Vinokurov and Yu. N. Ivanov *In its* Cosmic Res., Vol. 3, No. 4, 1965 8 Oct. 1965 p 56–64 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

A functional method is proposed for the solution of boundary problems for ordinary differential equations synthesizing the outlines of the Newton method and the method of steepest descent. The procedure for the solution is illustrated with a single numerical example from the region of motion in a central field. Author

**N66-13798#** Stanford Univ., Calif. Dept. of Mathematics.
**THE EFFECTIVE CONDUCTIVITY OF A REGULAR COMPOSITE MEDIUM**
Harold Levine 26 Jul. 1965 27 p refs
(Contract Nonr-225(74))
(TR-6; AD-622870) CFSTI: HC $2.00/MF $0.50

The advantages of a Green's function method are exemplified by the analysis of steady potential flow through a homogeneous medium containing a regular array of subdomains where a different value of the conductivity prevails. It is shown in particular, that the results previously obtained by Rayleigh for the square array of cylindrical obstacles with infinite conductivity are recovered in a more efficient manner; and that the method is suitable for handling either widely dispersed or closely packed arrays. Author (TAB)

**N66-13812#** Naval Research Lab., Washington, D. C.
**DIMENSIONAL PARAMETERS OF RESOLVED GLITTER FROM THE BAY OF PANAMA**
Kingsley G. Williams Sep. 1965 28 p refs
(NRL-MEMO-1642; AD-622571) CFSTI: HC $2.00/MF $0.50

Studies were made of the temporal and spatial distribution and dimensions of resolved reflections from a wind-stressed water surface in the Bay of Panama using a modification of Schooley's vertical flash technique at a photographic scale of 17:1. The mean spacing of 'glints' at wind velocities of 6–12 knots was about 0.5 inches leading to a maximum glitter density of 75,000 glints/sq ft/sec. Large waves reduced this density to a mean measured value of about 10,000 glints/sq ft/sec and an oil slick further reduced the density to about 360 glints/sq ft/sec. A mean maximum slope of about 9° was reduced by an oil slick to somewhat less than 4°. Glint dimensions averaged 0.04 × 0.14 inches for clean water and 0.07 × 0.29 inches for slick covered water. Distribution of numbers of glints as a function of slope was approximately Gaussian. Author (TAB)

**N66-13815#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**APPLICATION OF LINEAR OPTIMAL CONTROL THEORY TO THE FLEXIBLE BOOSTER**
Bruce Lee Solomon (M.S. Thesis) Aug. 1965 92 p refs
(GE/EE/65-24; AD-622991) CFSTI: HC $3.00/MF $0.75

A brief development of concepts and mathematics involved in frequency plane optimization, using a least integral error square with quadratic constraint performance index, is presented. The technique is applied to the problem of controlling a hypothetical flexible booster with quadratic constraint on the control. Problems arise from a RHP zero in the model of the booster. Results agree with results using conventional methods. Realizable compensation to yield a stable system could not be found. In contrast to conventional methods, this optimization technique allows precise solution. Trial and error and experience factors are minimized. Comparison with state space optimization shows frequency plane techniques superior in single input problems. Author (TAB)

**N66-13850*#** National Bureau of Standards, Washington, D. C.
**FLUX AVERAGING DEVICES FOR THE INFRARED**
S. Thomas Dunn 9 Dec. 1965 44 p refs
(NASA Order R-09-022-032)
(NASA-CR-68761; NBS-TN-279) CFSTI: HC $2.00/MF $0.50 CSCL 20F

The spatial and angular sensitivity of infrared detectors were investigated. In order to eliminate this effect and obtain accurate measurements in the infrared, it is necessary to distribute the flux as uniformly as possible over the entire sensitive area of the detector. A solution to this problem is presented in the form of several averaging devices. Among the devices investigated are roughened NaCl windows, diffusing light ducts, and spheres with different coatings. Each device was subjected to a series of tests to establish its averaging capability and useful wavelength range. Results of these tests indicate that the use of a small sulfur-coated hollow sphere over the detector increased the accuracy of most types of infrared reflectance measurements and, at the same time, decreased the requirement for precise optical alignment of the detector in the wavelength range of 1.5 to 8 microns. The use of the sulfur-coated sphere over a thermopile extends the usefulness of the multiple-reflection specular reflectometer to about 10 microns. Author

**N66-13913#** Sydney Univ. (Australia). School of Physics.
**[PREIONIZATION AND SHOCK WAVE IONIZATION PROCESSES IN SUPPER I. ALFVEN WAVE STUDIES, CURRENT INDUCED INSTABILITY, A 2 mm INTERFEROMETER, AND LASERS] Ninth Six-Monthly Progress Report, 1 Jan.–30 Jun. 1965**
[1965] 7 p refs
(NP-15355; PR-9) CFSTI: HC $1.00/MF $0.50

Progress is reported on preionization and shock wave ionization processes in SUPPER I, Alfven wave studies, current induced instability, a 2 mm interferometer, and lasers. NSA

**N66-13919#** Atomic Weapons Research Establishment, Aldermaston (England).
**THE PERMEATION AND DIFFUSION OF HYDROGEN ISOTOPES THROUGH STAINLESS STEELS. PART I: NIOBIUM STABILISED S110 STEEL**
R. Gibson, P. M. S. Jones, and J. A. Evans Sep. 1965 32 p refs
(AWRE-O-47/65) CFSTI: HC $2.00/MF $0.50

Measurements were made on the passage of hydrogen and deuterium through niobium stablized stainless steel S110 membranes 0.02 in. thick which had been cleaned with hydrogen or contaminated by treatment with nitrogen, oxygen, carbon dioxide, moist oxygen, or argon. Nitrogen and argon had no effect but oxygen reduced the permeation rate significantly. Full experimental results are reported and discussed. Permeation and solubility data agree well with previous results.
Author (NSA)

**N66-13920#** Atomic Energy Commission, Washington, D. C.
**PHYSICAL AND CHEMICAL PROBLEMS OF THE JOINING OF DISSIMILAR MATERIALS**
N. M. Rykalin, M. Kh. Shorshorov, and Ya. L. Krasulin [1964] 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorgan. Materialy (USSR), v. 1, no. 1, 1965 p 29–36
(AEC-TR-6615) CFSTI: HC $1.00/MF $0.50

The formation of joints between dissimilar materials with limited mutual solubility is discussed and examples are cited. Methods, equipment, properties of metals, and bonding effects in the formation of joints are considered. NSA

**N66-13921#** Oak Ridge National Lab., Tenn.
**STATISTICAL PROPERTIES OF NONLINEAR STRING**
F. M. Izrailev and B. V. Chirikov 1965 22 p refs Transl. into ENGLISH from RUSSIAN
(ORNL-TR-754) CFSTI: HC $1.00/MF $0.50

The qualitative behavior of the longitudinal oscillations of a nonlinear string with fixed ends and satisfying the equation $\partial^2 X/\partial t^2 = (\partial^2 X/\partial Z^2)\ [1 + 3\beta\ (\partial X/\partial Z)^2]$ is investigated. This problem was previously examined by the method of numerical integration for a chain of nonlinear oscillators approximately representing a string and satisfying the following system of ordinary differential equations: $\ddot{X}_2 = (X_{s+1} + X_{s-1} - 2X_s)\ \{1 + \beta\ [(X_{s+1} - X_s)^2 + (X_s - X_{s-1})^2 + (X_{s+1} - X_s)(X_s - X_{s-1})]\}$ where $1 = 1, 2, \ldots, N-1$; $Q = L$ and $L = N$. The boundary of stochastic instability for this system of oscillators is estimated. NSA

**N66-13922#** Oak Ridge National Lab., Tenn.
**ADHESION OF PARTICLES TO SURFACES IN LIQUID AND GASEOUS ENVIRONMENTS**
R. L. Walker and B. R. Fish 30 Aug. 1965 20 p refs Presented at the Ann. Meeting of the Am. Assoc. on Contamination Control, Miami, Fla.
(Contract W-7405-ENG-26)
(ORNL-TM-1228; CONF-650533-2) CFSTI: HC $1.00/MF $0.50

A review of the adhesive forces that retain particles on surfaces and of forces available to remove them, suggests methods for selecting decontamination techniques. In normal atmospheric environments, the major components of adhesion appear to be capillary, molecular, and electrostatic forces. In liquid systems, electrostatic or molecular forces may predominate; however, it is pointed out that a time dependent force, due to Stefan flow, may affect particle removal from surfaces. Forces available for removing particles from surfaces may be fluid dynamical, inertial, or direct mechanical contact. The efficient choice of a cleaning procedure requires an understanding of the relationships between forces of adhesion and available removal forces. Research on the adhesion of particles in normal atmosphere indicates that the adhesive force depends strongly on the relative humidity. Similar studies in liquids generally show much lower adhesive forces than in air, by approximately two orders of magnitude. Author (NSA)

**N66-13969#** Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
**STIMULATED SCATTERING FROM A SEMI-INFINITE DISPERSIVE MEDIUM PERIODIC IN TIME AND SPACE Research Report No. 53**
J. Askne 1 Jun. 1965 53 p refs *Its* Tech. Note No. US-43
(Contract AF 61(052)-451)
(AFCRL-65-689; AD-623657) CFSTI: HC $3.00/MF $0.50

The problem of wave interactions in a dispersive medium with a density periodic in time and space due to a high power pump wave, is treated. Waves are shown to be caused by both scattering and boundary processes. Conditions for parametric traveling wave resonance are found. Generalized Fresnel formulas are given for parallel and perpendicular polarization.
Author (TAB)

**N66-13982#** RAND Corp., Santa Monica, Calif.
**THE WAKE OF A LARGE BODY MOVING IN THE IONOSPHERE**
Phyllis Greifinger Sep. 1965 47 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-3808-ARPA; AD-623330) CFSTI: HC $2.00/MF $0.50

The memorandum investigates the steady-state perturbations of the ion and electron densities caused by a large-radius conducting disk moving through the ionosphere at a speed intermediate to the ion and electron thermal speeds. An approximation to the electron density in the region close behind the body is found by solving Poisson's equation, neglecting the ion density. For larger distances behind the body where the ion and electron densities are almost equal, an expression for the Fourier transform of the perturbed ion density is obtained, taking account of the ion thermal motion and scattering in the electric and magnetic fields, but neglecting collisions. The transform is inverted to obtain an approximate expression for the space dependence of the perturbation at large distances. Finally, the solutions for different body shapes and boundary conditions are discussed. Author (TAB)

**N66-14078#** European Atomic Energy Community, Brussels (Belgium).
**THERMAL AND MECHANICAL STUDIES OF SOLID–SOLID CONTACTS**
C. Mustacchi and S. Giuliani Aug. 1965 53 p refs
(EUR-2486.e) CFSTI: HC $3.00/MF $0.50

Bearing curves of solids with several surface finishes are studied. Experimental and theoretical analyses are made of the thermal situation of a solid–solid contact with particular emphasis on the fuel-pellet-clad interaction in a nuclear reactor fuel element. Author

**N66-14100*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Afro-Astrodynamics Lab.
**GROUND LEVEL ACOUSTICAL FOCI IN A THREE-LAYERED ATMOSPHERE**
Willi H. Heybey 7 Oct. 1965 47 p refs
(NASA-TM-X-53344) CFSTI: HC $2.00/MF $0.50 CSCL 20A

An infinitesimally slender bundle of sound rays emitted by a point source can, under certain meteorological conditions, be returned to the horizontal plane on which the source sits, and at the same time, may be narrowed down to enclose an area actually equal to zero. In such cases the common point of arrival is called an acoustical focus. The intensity of returned energy there attains a very high degree capable of damaging effects. For determining such points the atmosphere is usually divided up into layers in each of which the change of the sound speed with height is considered constant. Three layers often suffice to approximate the many layers arising from observation. The report studies focus formation engendered by the third layer in collaboration with the two lower layers. A focus may appear in variegated circumstances. For each case a computational scheme is given which may be followed by slide rule or assigned to machines if higher accuracy or a systematic survey is desired. Author

**N66-14112*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**SOME THEORETICAL ASPECT OF CRYOSORPTION**

L. A. Veguilla-Berdecia *In its* Goddard Summer Workshop Program [1964] 14 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The physical aspects of cryosorption and adsorption are reviewed and the application of the potential theory to the problem of cryosorption at very low pressures is considered. The system considered is the cryosorption of hydrogen on an aluminosilicate molecular sieve. The properties of gaseous hydrogen and the 20° K adsorption isotherm for hydrogen on the molecular sieve are tabulated. Using the modified Berenyi expression curves for the Linde data are obtained and results for various pressures are given. E.E.B.

**N66-14126*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**CONTOUR CURVES FOR THE AXIAL MAGNETIC FIELD OF A FOUR-DIPOLE SYSTEM**

Francine Wright *In its* Goddard Summer Workshop Program [1964] 1 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The contours are plotted for an axial magnetic field of a four dipole system. The horizontal axis represents the distance along the axis of the system and the vertical axis of the graph represents the radial distance. The 1.000 contours, which are nearly straight lines radiating from the origin, have the same field intensity as the center of the system. The contours at about 45° have greater field intensities than exist at the center of the system. The magnetic field decreases more rapidly in the axial direction than in the radial direction. E.E.B.

**N66-14130*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**ELECTRIC FIELD OF FOUR CHARGED RINGS**

A. V. Dralle *In its* Goddard Summer Workshop Program [1964] 5 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The need for controlled electric fields, highly homogeneous over a large volume, which can arise from the calibration of electric field instruments or from future complete environmental studies of spacecraft, is discussed. Investigations were made of a possible method of achieving these fields with four symmetrically spaced charged circular rings. The theory is discussed and parameters derived for the four ring system. E.E.B.

**N66-14136#** National Bureau of Standards, Boulder, Colo.

**REFRACTIVE INDEX AND DISPERSION OF LIQUID HYDROGEN**

R. J. Corruccini 24 Sep. 1965 25 p refs (NBS-TN-323) GPO: $0.25

The published experimental values of the refractive index of liquid hydrogen have been correlated by calculating and comparing the values of the Lorentz–Lorenz ratio as a function of wavelength. Because of the scatter found by this analysis, it is proposed that more accurate values can be calculated from available data of other kinds, namely, the dielectric constants determined by Stewart and the optical dispersion determined for the gas at STP. Formulas for this calculation are given. Author

**N66-14157*#** Israel Program for Scientific Translations, Ltd., Jerusalem.

**MECHANICS OF GYROSCOPIC SYSTEMS**

A. Yu. Ishlinskii 1965 316 p refs Transl. into ENGLISH of the book "Mekhanika Giroskopicheskikh Sistem" Moscow, Izd. Akad. Nauk SSSR, 1963 Prepared for NASA and NSF (NASA-TT-F-286; TT-65-50112) CFSTI: HC $7.00/MF $1.75 CSCL 20

A wide range of problems in mechanics connected with the practical application of gyroscopes are discussed. The solutions of geometric problems of the kinematics of gimbal systems; and of geometric problems connected with the accuracy of orientation of gyro-controlled objects are considered. Also considered are phenomena connected with the elasticity of gyro-system elements; methods for establishing equations of motion of gyroscopic systems; nonlinear behavior of forces acting on gyroscopic systems; and various other gyroscopic problems. In addition, the equations of motion for determining the position of an object moving arbitrarily on the earth, and the theory of complex gyroscopic stabilization systems are given. L.S.

**N66-14224*#** Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

**IMPROVED MAGNETIC COMPONENTS FOR STATIC INVERTERS AND CONVERTERS Seventh Quarterly Report, Dec. 29, 1964–Mar. 30, 1965**

R. E. Mc Vay et al [1965] 38 p (Contract NAS3-2792) (NASA-CR-54645; WAED-65.44E) CFSTI: HC $2.00/MF $0.50 CSCL 20C

Sine current screening CCFR and sine flux screening core loss tests were made on part of the test program materials. Square wave CCFR tests at 400, 800, 1600, and 3200 cps were made on part of the test materials. Results are tabulated. A description of the annealing treatments for the materials, the equipment check out problems, the program drawings and the toroidal core description are given. A proposed change in shock testing is discussed. The noise testing facilities are discussed. Author

**N66-14233#** Tufts Univ., Medford, Mass. Dept. of Chemistry.

**PRESSURE BROADENING OF ROTATIONAL LINES**

Carl O. Trindle and Karl H. Illinger 30 Sep. 1965 21 p refs (Contract Nonr-494(19)) (AD-622505) CFSTI: HC $1.00/MF $0.50

A computational framework was developed which, judiciously applied, can treat the problem of the change in the absorption intensity function with temperature and pressure, given an

intermolecular potential. Conversely, experimental results may be analyzed with the goal of calculating the constants in the interaction potential. The present analysis lends itself to a detailed study of the effect of the various approximations entering into line-broadening theory, and may aid in the development of higher-order treatments based upon the assessment of underlying assumptions in current treatments. The further goals of this work include the description of the details of the pressure broadening of microwave spectral lines, for example, frequency shifts, breadths and the first few moments of the intensity function, which will diagnose the asymmetry of the line. The basis of this description is the further analysis of the intensity function derived via a direct calculation of the Heisenberg matrix elements. One may then seek further a simple means of evaluating the constants of the intermolecular potential by the experimental values for the frequency shift and the line-shape parameters. Author (TAB)

**N66-14289*#** Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
**FEASIBILITY OF OBJECTIVE COLOR SYSTEMS Final Report**
Abraham Anson 13 Sep. 1965 39 p refs
(NASA Order R-47-009-002)
(NASA-CR-68982) CFSTI: HC $2.00/MF $0.50 CSCL 20F

Several approaches, used to determine the feasibility of objective sensing of color for manned space geoscience application, are discussed. These involved the development of a small spectrum analyzer and tristimulus sensor; the fabrication of three filters for use in a tristimulus sensor; and a color stereo-effect experiment requiring the attachment of optical wedges to standard photographic cameras. Details are given on each experiment. Results indicate: (1) Lightweight portable spectrum analyzers can be made and used for sensing the spectral response of unknown terrain by scanning. (2) Tristimulus sensors can be made portable and reasonably accurate; however, their value is diminished since they yield chromaticity rather than spectra. (3) Color stereo-effect sensors do not seem realistic as the parallaxes are about the same magnitude as the random errors. It is pointed out that this phenomenon has a dramatic visual effect and could have other applications, such as enhancement of visibility and the recognition of colored objects in unfamiliar visual environments. M.G.J.

**N66-14294*#** Grumman Aircraft Engineering Corp., Bethpage, N. Y.
**TABULATED RESULTS OF CALCULATED MOLECULE-SURFACE INTERACTIONS**
Alexander Bogan, Jr. Jul. 1964 72 p refs
(Contract NASw-709)
(NASA-CR-68976; RM-237) CFSTI: HC $3.00/MF $0.75 CSCL 20

This memorandum presents a tabulation of the numerical results obtained from a series of computer calculations of the interactions of gas molecules with solid surfaces. The tabulations include mean interaction parameters and their standard deviations for 64 physical states, each represented by 18 molecular trajectories. Author

**N66-14304#** New York Univ., N. Y. Div. of Electromagnetic Research.
**GEOMETRIC OPTICS AND THE PLARIZATION VECTORS**
Robert M. Lewis Jul. 1965 7 p ref
(Contract AF 19(628)-4065)
(EMp-209; AFCRL-65-612; AD-623125) CFSTI: HC $1.00/MF $0.50

Classical geometrical optics provides simple rules for the construction of electromagnetic fields. However the rules are incomplete in that the directions of E and H are not completely determined. The usual rules can be derived from an asymptotic solution of Maxwell's equations. This process also yields equations for the direction of E and H. These equations are shown to yield a very simple direction rule which completes the geometrical optics determination of the fields. Author (TAB)

**N66-14311#** Brown Univ., Providence, R. I.
**STUDY OF SURFACE PROPERTIES OF ATOMICALLY-CLEAN METALS AND SEMICONDUCTORS Progress Report, 1 Jan.–30 Jun. 1965**
H. E. Farnsworth, B. D. Cambell, and M. Onchi Jul. 1965 29 p refs
(Contract DA-28-043-AMC-00299(E))
(PR-7; AD-623174) CFSTI: HC $2.00/MF $0.50

The (000/1) MATTE natural growth surface of a vapor grown CdS crystal which had not been polished or etched was studied. It was not possible to obtain a clean surface by heating alone because of contamination from the bulk. Ion bombardment and annealing produced (10/1/4) planes as was found on previously studied crystals. Oxygen adsorption studies of the (000/1) MATTE surface, after using Ga-In eutectic to make contact to the crystal mount, were made. However, the magnitude of these changes was not reproducible. Oxygen adsorption studies of the (0001) SPECULAR surface with no Ga-In contact revealed that photoassisted adsorption occurred. The change in surface potential was approximately directly proportional to the change in oxygen coverage as estimated from decreases in diffraction pattern intensities. This indicates that the oxygen forms negative surface states. The system involving a combination of LEED and quadrupole mass spectrometer was assembled and tested with self oxidation of CO on a (100) nickel crystal surface. (The diagonal mark (1) is here used to indicate the rotation-inversion axis). TAB

# 24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

**N66-13512#** Rensselaer Polytechnic Inst., Troy, N. Y.
**LINEAR ACCELERATOR PROJECT Annual Technical Report, 1965**
Erwin R. Gaerttner [1965] 115 p refs
(Contract AT(30-3)-328)
(TID-22141)

Separate abstracts were prepared for seven sections of the report. The remaining papers deal with the radiolysis of carbon monoxide, electron irradiation of germanium and silicon, and transient radiation damage in silicon. NSA

**N66-13524#** Stanford Univ., Calif. Stanford Linear Accelerator Center.
**STANFORD LINEAR ACCELERATOR CENTER STORAGE RING SUMMER STUDY, 1965 ON INSTABILITIES IN STORED PARTICLE BEAMS A Summary Report**

B. Richter, M. Sands, and A. M. Sessler, ed. Aug. 1965 81 p refs
(Contract AT(04-3)-515)
(SLAC-49) CFSTI: $3.00

Brief reports of the principle results which came forth from the Storage Ring Summer Study are summarized. The interest of the study is in high-energy particle research with colliding beam storage rings. Extensive consideration is given to longitudinal wake fields of a pulse of charge moving down a straight pipe of circular cross section with finite conductivity, asymptotic perturbation field of a longitudinally bunched beam within a rectangular pipe with resistive walls, wake fields of a charged particle traveling in a vacuum chamber with resistive walls, transverse coherent instability of bunched beams, transverse stability of ultra-relativistic multiple-bunched beams, influence of dielectric media on the electromagnetic fields of a coasting beam in a straight rectangular pipe, media effects on the electromagnetic fields of a coasting beam in a straight pipe of circular cross section, theory of coherent bunch motion in electron-positron storage rings, longitudinal resistive instability for an azimuthally bunched beam, incoherent beam blow-up in colliding beams, and one-dimensional computations of particle trajectories in colliding beams. The problems which motivated the specific and detailed investigations and the results obtained are discussed. M.R.W.

**N66-13613#** National Bureau of Standards, Boulder, Colo. Inst. for Materials Research.
**SURFACE TENSIONS OF NORMAL AND PARA HYDROGEN**
R. M Corruccini 11 Aug. 1965 20 p refs
(NBS-TN-322) GPO: $0.20

A note is presented showing that published data on the surface tensions of normal hydrogen are in agreement within about 1% if properly computed. Application of the meniscus corrections in older investigations is examined, and the resulting corrected data are represented by functions and a table suitable for linear interpolation. C.T.C.

**N66-13628#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
**ENERGY GAP IN NUCLEAR MATTER IN THE CASE OF SOFT CORE POTENTIALS**
P. Boshan 1965 10 p refs In RUSSIAN Submitted for Publication
(JINR-P-2176) CFSTI: HC $1.00/MF $0.50

An equation for the gap was solved in the case of soft core potentials. For the potentials obtained from the scattering data the gap is absent. In the case of the effective potential the finite nuclei gap was obtained which coincides approximately with the experimental one. Author (NSA)

**N66-13640*#** State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
**LOW-ENERGY PROTON AND ELECTRON EXPERIMENT FOR THE ORBITING GEOPHYSICAL OBSERVATORIES B AND E**
L. A. Frank Jul. 1965 35 p *Its* Rept.-65-22
(Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-68558) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The instrumentation and calibrations of the University of Iowa low-energy proton and electron experiment for the Orbiting Geophysical Laboratories (OGO) B and E are decribed The experiment utilizes cylindrical curved-plate electrostatic analyzers to provide measurements of the differential energy spectrums of protons and electrons within and in the vicinity of the earth's magnetosphere. Continuous channel multipliers (Bendix 'Channeltrons') are used to count individual charged particles accepted by the analyzers and provide the instrument with a dynamic range in proton and electron intensities extending from $10^4$ to $10^{10}$ $(cm^2\text{-sec-sr})^{-1}$ in a given energy bandpass of the electrostatic analyzer. The widths of the energy bandpasses of the electrostatic analyzers are sufficiently wide to cover the entire energy range extending from 90 eV to 70000 eV (protons and electrons separately) in 14 voltage steps on the curved plates. The four electrostatic analyzers (two analyzers each for protons and electrons covering the above energy range) complete with signal conditioner, high-voltage power supplies, and thermal shell require an average power of 2 watts and an instrumental weight of 6.3 pounds. Author

**N66-13651#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
**ON THE OBSERVED ISOSPIN VIOLATION IN THE $^{10}B$-($^6Li$,d)$^{14}N$ REACTION**
I. Rotter 1965 6 p refs
(JINR-E-2244) CFSTI: HC $1.00/MF $0.50

An explanation of the "violation of the isospin selection rule" observed in the B(Li-6,d)$^{14}N$ reaction is suggested in terms of mixing of the T = 1 level at 9.17 Mev with α-threshhold levels. Author (NSA)

**N66-13653#** Oak Ridge National Lab., Tenn.
**A NEW INTERPRETATION OF THE MATHEMATICAL INTERRELATIONSHIPS OF RADIOACTIVE DECAY**
M. Wolfke [1965] 6 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 30, 1929 p 899-901
(ORNL-TR-707) JCL: HC $1.10/MF $0.80

From the decay law of atoms of a uniform radioactive substance ($-dn/dt = \lambda n$), it is generally concluded from this equation that the decay probability for the individual atom at a given moment is independent of its age and is constant at any time during its life. It is shown that the conclusion mentioned above is not binding because this equation can also be obtained when the role of coincidence is limited only to the moment of formation of the atom and when its further fate is considered to be a consequence of a singularly proceeding mechanism. NSA

**N66-13660#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**POLARIZATION IN N-α SCATTERING AT $E_n$ = 25, 28, AND 34 MeV [POLYARIZATSIYA V N-α RASSEYANNI PRI $E_n$ = 25, 28, I 34 MeV]**
V. R. Arifkhanov, N. A. Vlasov, V. V. Davydov, and L. N. Samoilov 1965 13 p refs In RUSSIAN
(IAE-834) CFSTI: HC $1.00/MF $0.50

Polarized neutrons with energies 25, 28, and 34 Mev were obtained in the T(d,n)$^4$He reaction at 30°. Measurements were carried out of the asymmetry of scattering of these neutrons on helium at various angles from 45 to 150°. The results obtained were compared with the angular dependence of the polarization in p-α scattering, interpolated to the same values of proton energy according to existing data for other energies (22, 29, and 40 Mev). Satisfactory agreement was found of the angular dependence of the asymmetry of n-α and p-α scattering, and the same divergence of them from the predictions of the phase analysis, extrapolated from the energy range <20 Mev, was observed. An initial estimate of the polarization in n-α scattering is given on the basis of the agreement with the polarization in p-α scattering. NSA

**N66-13664#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**CP-PARITY NON-CONSERVATION IN POLARIZED NEUTRON DECAY [NESOKHRANENIE SR-CHETNOSTI V RASPADE POLYARIZOVANNOGO NEITRONA]**

G. A. Lobov 1965 11 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-332

(NP-15460) CFSTI: HC $1.00/MF $0.50

On the basis of the effective hamiltonian containing baryonic currents of the first and second class (six form-factors) the spin correlation $\vec{S}(\vec{P}_p \times \vec{P}_e)$ ($\vec{S}$ —is neutron spin vector, $\vec{P}_p, \vec{P}_e$ are the proton and electron momenta) in polarized neutron decay was calculated. Models where CP-parity nonconservation is due to the currents of the second class and to the presence of imaginary part in the constant of axial-vector interaction are discussed. The problem of emerging of spin correlation $\vec{S}(\vec{P}_p \times \vec{P}_e)$ due to the Coulomb interaction of proton and electron in final state was investigated.

Author (NSA)

**N66-13668#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**REGGE POLE IN A COULOMB-WELL TYPE POTENTIAL [POLYUSA REDZHE V POTENSIALE TIPA KULONOVSKOI YAMY]**

V. A. Kolkunov and G. A. Lobov 1964 29 p refs In RUSSIAN; ENGLISH summary

(NP-15454) CFSTI: HC $2.00/MF $0.50

On the basis of exact solution of Schroedinger equation Regge poles motion depending on the energy for a Coulomb well potential is investigated. This potential coincides with the Coulomb one at small distances and behaves as a square-well potential at large distances. The pole trajectories in a Coulomb well potential at low and mean energies are shown to be of Regge character. The pole trajectories asymptotics at high energies coincide with the Coulomb case. Author (NSA)

**N66-13669#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**REGENERATION PHENOMENA AND COMBINED EXPERIMENTS IN A NEUTRAL K-MESON BEAM [YAVLENIYA REGENERATSII I POLNYI OPYT V PUCHKE $K^0$ MEZONOV]**

V. V. Vladimirskii and M. V. Terent'ev 1965 16 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-323

(NP-15470) CFSTI: HC $1.00/MF $0.50

Regeneration phenomena in the meson ($K^0$) beam are studied without any assumptions about CP and CPT parity conservation. The combination of experiments is studied to determine a series of parameters characterizing regeneration and character of CP (and may be CPT) parity non-conservation.

Author (NSA)

**N66-13672#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**SINGLE-PARTICLE EFFECTS IN NEUTRON PHYSICS AND THE FINE STRUCTURE OF NUCLEAR MASSES. III: CORRELATIONS IN POSITIONS OF NEUTRON LEVELS [ODNOCHASTICHNYE EFFEKTY V NEITRONNOI FIZIKI I TONKAYA STRUKTURA YADERNYKH MASS. III: KORRELYATSII V POLOZHENIYAKH NEITRONNYKH UROVNEI]**

S. I. Sukhoruchkin 1965 29 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-347

(NP-15467) CFSTI: HC $2.00/MF $0.50

Comparison of neutron levels position for all nuclei shows a certain grouping effect, more pronounced for levels with relatively large reduced neutron widths. If one analyzes all nuclei; the coincidences of resonances lying close to binding energy are frequently obtained. Author (NSA)

**N66-13674#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**SYMMETRY OF STRONG INTERACTIONS AND THE $SU_4$ GROUPS [SIMMETRIYA SIL'NYKH VZAIMODEISTVII I GRUPPA $SU_4$]**

V. V. Vladimirskii 1964 65 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-290

(NP-15471) CFSTI: HC $3.00/MF $1.00

Representations of $SU_4$ group are considered and possibility of construction of strongly interacting particles compound model using four baryons as a basis is investigated. It is shown that the known unitary supermultiplets can be parts of the more complex families of particles and resonances satisfying the higher symmetry $SU_4$. Symmetry violation and mass formulas are investigated. The tables of the main representations are given.

Author (NSA)

**N66-13851#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Inst.

**CALCULATING DIFFERENTIAL CROSS SECTIONS OF SLOW NEUTRONS BY MEANS OF INTEGRATION WITH RESPECT TO TIME [VYCHISLENIE DIFFERENTSIAL'NYKH SECHENII MEDLENNYKH NEITRONOV S POMOSHCH'YU INTEGRIROVANIYA PO VREMENI]**

V. F. Turchin 1965 18 p refs *Its* Rept.-6 In RUSSIAN

(NP-15469) CFSTI: HC $1.00/MF $0.50

A method is described for calculating the differential cross sections of scattering of slow neutrons by crystalline and liquid materials in the noncoherent approximation, using direct integration with respect to time. The algorithm on the basis of which the programs for the calculation of $d^2\sigma/dEd\Omega$ and $d\sigma/dE$ are set up is described. An explanation is proposed for the effect of the spasmodic change of the total scattering cross section of slow neutrons during the transition of ice into water. It is shown that the increase of the cross section proceeds at the expense of additional inelastic scattering in water. The calculation of the effect agrees satisfactorily with the experiments of Heinloth. Author (NSA)

**N66-13853#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

**ELASTIC (p,p)-SCATTERING AT 1.45 BeV [UPRUGOE (p,p)-RASSEYANIE PRI 1.45 BeV]**

S. P. Kruchinin, K. N. Mukhin, A. S. Romantseva, I. A. Svetlolobov, M. M. Sulkovskaya et al 1964 17 p refs In RUSSIAN

(IAE-700) CFSTI: HC $1.00/MF $0.50

A propane bubble chamber was used to investigate the angular dependence of elastic scattering of protons by protons at an incident-proton momentum of 2.2 Bev/c, which is higher than the energies used in earlier investigations. A total of 17,000 pairs of stereophotographs was scanned, ~900 cases of elastic $\pi^+p$ and pp scattering cases were analyzed, and the reduction of these data made it possible to determine the differential cross section of elastic pp scattering at 1.45 Bev over the entire angle interval of 0 to 90° (cms). Calculations based on the optical model with a small region of

phase shift gave best agreement with the experimental data with parameter values $R_1 = 0.45$ F, $R_2 = 0.95$ F, $a = 0.344$, and $\phi = 1.77$ rad. (R—interaction radius, $\phi$—phase shift, a—amplitude of transmitted wave for a unit amplitude of incident wave). In the energy region from 0.38 to 30.9 Bev, the differential cross section is proportional to A exp $(-P_{cm}/P_0)$, with A = 115 mb/sr and $P_0 = 143$ Mev/c. NSA

**N66-13855#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**ANHARMONISM INFLUENCE ON THE PHONON SPECTRUM NEAR THE POINT OF ORIGIN [VLIYANIE ANGARMONIZMA NA SPEKTRFONONOV VBLIZI TOCHKI VYROZHDENIYA]**
Yu. Kagan and A. P. Zhernov 1964 13 p refs In RUSSIAN; ENGLISH summary
(IAE-750) CFSTI: HC $1.00/MF $0.50

Green's function method is used for the analysis of anharmonism influence on phonon spectrum near a degeneracy point. The independent effects in harmonic approximation of phonon branches on each other in contrast to the usual case makes it necessary the solving of the Dyson equation system. The cases of essential and accidental degeneracy are considered. It is shown that at accidental degeneracy the occurring excitations may have strongly differing lifetimes and frequency renormalizations both in value and in temperature dependence. The cross section of single-phonon coherent neutron scattering near the degeneracy point is especially analyzed. Author (NSA)

**N66-13861#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**ISOTOPE-SHIFT AND QUADRUPOLE MOMENTS OF NEARSPHERICAL NUCLEI [IZOTOPICHESKOE SMESHCHENIE I KVADRUPOL'NYE MOMENTY OKOLOSFERICHESKIKH YADER]**
G. G. Bunatyan and M. A. Mikulinskii 1964 16 p refs In RUSSIAN
(IAE-717) CFSTI: HC $1.00/MF $0.50

The isotopic shift and the quadrupole moments of nuclei that are close to spherical were calculated on the basis of the theory developed by A. B. Migdal for the Fermi liquid of finite systems. Use was made in the calculations of eigenfunctions and eigenvalues of an effective hamiltonian with a Woods-Saxon potential and with spin-orbit coupling. The matrix elements were calculated and the linear equations solved by means of an electronic computer. An analysis of the results leads to the conclusion that in order to reconcile the data with experiment it is necessary to introduce an interaction amplitude which changes sign and magnitude on the boundary of the nucleus. The values of the internal and external constants involved in the theory are determined. Author (NSA)

**N66-13862#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
**DIRECT KNOCK-OUT AND INELASTIC SCATTERING REACTIONS [PRAYAMIYE REAKTSII VYBIVANIYA I NEYPRUGOGO RASSEYANIYA]**
S. F. Timashev 1965 19 p refs In RUSSIAN; ENGLISH Summary *Its* Rept.-327
(NP-15468) CFSTI: HC $1.00/MF $0.50

The formulas were obtained for the amplitude of the triangle graph of the knock-out reaction in the general case of particles with arbitrary masses and spin. Author (NSA)

**N66-13865#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**THE ELASTIC SCATTERING OF Λ-HYPERONS WITH THE AVERAGE MOMENTUM (2.7 ±/∓ RESPECTIVELY 1.2) GeV/C ON PROTONS [UPRUGOE RASSEYANIE Λ-GIPERONOV SO SREDNIUM IMPULSOM 2.7 GeV/c NA PROTONAKH]**
V. F. Vishnevskii, Yuan-Tsai Tu, V. I. Moroz, A. V. Nikitin, Yu. A. Troyan et al 1965 12 p refs In RUSSIAN
(JINR-P-2257) CFSTI: HC $1.00/MF $0.50

The elastic scattering total cross section of Λ-hyperons with the average momentum $\bar{P}_\Lambda = (2.7 \pm 1.2)$ Bev/c on protons is experimentally found to be $(1.5 \pm 4)$ mb. This result is compared with the known theoretical and experimental data. Author (NSA)

**N66-13868#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**DECAYS IN A MIXED ENSEMBLE OF NEUTRAL K-MESONS [RASPADY I SMESHANNOM ANSAMBLE NEITRAL'NYKH K-MEZONOV]**
V. L. Lyuboshits 1965 15 p refs In RUSSIAN
(JINR-P-2289) CFSTI: HC $1.00/MF $0.50

A description of the decay properties of a mixed ensemble of neutral K-mesons is considered with the aid of a two row density matrix. The case when the neutral K meson enters the $K^0\bar{K}^0$ system is investigated in detail. From the new point of view the interference effects occurring by the decay of neutral K mesons into two $\pi$ mesons are discussed for the case of CP violation. Author (NSA)

**N66-13869#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
**DECAY OF BARYONS AND MESONS WITH THE FORMATION OF AN ELECTRON-POSITRON PAIR IN THE U(12) SYMMETRY SCHEME [RASPAD BARIONOV I MEZONOV S OBRAZOVANIEM ELEKTRONNO-POZITRONNOI PARY V SKHEME SIMMETRII U12]**
Dao Wong Duc 1965 8 p refs In RUSSIAN
(JINR-P-2284) CFSTI: HC $1.00/MF $0.50

The decay of baryons and mesons accompanied by the formation of an electron-positron pair is considered under U(12) symmetry. Expressions for the energy spectrum of finite baryon and meson are found. These can be compared with experiment. Author (NSA)

**N66-13870#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
**ON $^{158}$Er AND $^{157}$Ho ISOTOPES. THE FORMATION OF $^{162}$Ho IN THE Ta + p (660 MeV) REACTION [OBIZOTOPAKH $^{158}$Er I $^{157}$Ho. OBRAZOVANIE $^{162}$Ho V REAKTSII Ta + p (660 MeV)]**
K. Ya. Gromov and F. N. Muzhtasimov 1965 7 p refs In RUSSIAN
(JINR-P-2275) CFSTI: HC $1.00/MF $0.50

The spectrum of conversion electrons arising by the decay of neutron-deficient isotopes of Er and Ho was investigated with a $\beta$-spectrograph. The resolving power of the device was about 0.06%, the accuracy in the energy determination was about 0.05%. The data confirming the existence of the $^{158}$Er and $^{157}$Ho were obtained. It is established for the first time that in the bombardment of Ta with 660 Mev protons an isotope $^{162}$Ho is created. Author (NSA)

**N66-13871#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
**CHARGING DEVICE FOR PULSED MAGNETIC FIELD POWER SUPPLY [ZARYADNOE USTROISTVO DLYA PITANIYA USTANOVKI IMPUL'SNYE MAGNITNYE POLYA]**
V. K. Makar'in and V. P. Martem'yanov 1964 17 p In RUSSIAN
(IAE-704) CFSTI: HC $1.00/MF $0.50

A power supply is described for the production of pulsed magnetic fields in bubble, spark, and emulsion chambers used with high-energy particle accelerators. The pulsed magnetic field is produced by discharging a capacitor bank through an inductance coil. The equipment is capable of high-energy storage (~6950 kJ). Because of the use of ignitrons in the rectifier circuit and because of the inductive properties of the circuit, the battery is never discharged completely. It is recharged between the accelerator discharges, which are produced at intervals from 2 to 10 sec. The circuit, the operating principle, the automatic control, and the protective devices are described. The rectifier was used to charge a capacitor bank of 0.162-F capacitance to 4.5 kv. With the battery discharged to 3.5 kv, the rectifier is able to restore the initial 4.5-kv voltage within approximately 5 sec. NSA

**N66-13873#** General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
**EXPERIMENTAL DETERMINATION OF NEUTRON INELASTIC SCATTERING IN POLYETHYLENE**
W. L. Whittemore 22 Jul. 1965 23 p refs Presented at the Symp. on Inelastic Scattering of Neutrons by Condensed Systems, Brookhaven Natl. Lab., Upton, N. Y., 20–22 Sep. 1965
(Contract AT(04-3)-167)
(GA-6547; Conf-650932-3) CFSTI: HC $1.00/MF $0.50

The cross sections for inelastic scattering of neutrons by polyethylene at 0.167, 0.233, 0.408, and 0.499 ev were measured at angles of 30, 60, 90, and 150°. The results were compared with theoretical calculations. NSA

**N66-13874#** Los Alamos Scientific Lab., N. Mex.
**THE BAND STRUCTURE, SPECIFIC HEAT, MAGNETIC SUSCEPTIBILITY, AND ANOMALOUS THERMAL EXPANSION OF DELTA PLUTONIUM**
E. A. Kmetko [1964] 34 p refs Presented at the Roy. Commonwealth Soc., 3d Intern. Conf. on Plutonium, London, 26 Nov. 1965
(Contract W-7405-ENG-36)
(LA-DC-7351; Conf-651102-8) CFSTI: HC $2.00/MF $0.50

A rigid, multiple band model, some features of which were suggested by the calculated eigenvalue of the plutonium atom, was assumed for delta plutonium. By finding conditions under which the model accounts for various properties of the metal, some details of the band structure were determined. The outstanding feature is the small breadth of the 5f5/2 band, around 0.4 ev. The system consisting of this narrow band superimposed upon a much broader 6d band accounts for the negative expansion coefficient as well as for its dependence upon electron concentration as alterable by alloying, the most satisfactory agreement occurring for a 5f-band population of no more than four or five electrons per atom. The contraction is the result of atomic size reduction due to the loss of 5f electrons. The high electronic specific heat (3 cal/mole-°K) and the large magnetic susceptibility, assumed to consist entirely of spin paramagnetic and diamagnetic terms, are also accounted for by the mode. Author (NSA)

**N66-13875#** United Kingdom Atomic Energy Authority, Harwell (England).
**ANALYSES OF PARA-ORTHO HYDROGEN AND DEUTERIUM BY GAS CHROMATOGRAPHY**
Katsuyoshi Fujita and Takao Kwan Mar. 1965 14 p refs Transl. into ENGLISH from Bunseki Kagaku (Japan), no. 12, 1963 p 15–19
(NP-TR-1289) CFSTI: HC $1.00/MF $0.40

Two methods for the gas chromatographic determination of hydrogen nuclear spin isomers and isotopes were investigated with special reference to their accuracy and practicability. One is based on utilizing two sorts of column packings connected in series as previously proposed (J. Phys. Chem., 65: 190(1961)); the first contains alumina and the second alumina coated with manganese chloride. The chromatogram may yield four peaks corresponding to p-$H_2$, o-$H_2$, HD, and $D_2$. The other needs two acts for the analysis. A portion of hydrogen sample is introduced on alumina column which gives rise to three peaks corresponding to p-$H_2$, o-$H_2$ plus HD, and $D_2$ respectively. The remaining portion is introduced on alumina—manganese chloride column by which three peaks corresponding to $H_2$, HD, and $D_2$ may be obtained. By these methods the composition of four hydrogen molecular species may be determined. Both were applied to the quantitative analysis of hydrogen isomers and isotopes of known composition. All peaks appeared within 5–15 min, the composition being agreed with the expected value within ±2% accuracy. Author (NSA)

**N66-13878#** California Univ., Berkeley. Lawrence Radiation Lab.
**MEASUREMENT OF THE POLARIZATION PARAMETER IN PROTON-PROTON SCATTERING FROM 1.7 TO 6.1 BeV**
Paul Dutton Grannis (Ph.D. Thesis) 20 Aug. 1965 109 p refs
(Contract W-7405-ENG-48)
(UCRL-16070) CFSTI: HC $4.00/MF $0.75

The polarization parameter in proton-proton scattering is measured at incident proton kinetic energies of 1.7, 2.85, 3.5, 4.0, 5.05, and 6.15 Bev for four-momentum-transfer squared between 0.1 and 1.0 $(Bev/c)^2$. The experiment was done with an unpolarized proton beam from the Bevatron striking a polarized proton target. Both final state protons were detected in coincidence and the asymmetry in counting rate for target protons polarized parallel and antiparallel to the scattering normal was measured. The maximum polarization was observed to decrease from 0.4 at 1.7 Bev to 0.2 at 6.1 Bev. The maximum of the polarization at all energies studied occurs at a four-momentum-transfer squared of 0.3 to 0.4 $(Bev/c)^2$. Author (NSA)

**N66-13902#** European Atomic Energy Community, Brussels (Belgium).
**DATA HANDBOOK FOR SENSITIVITY CALCULATIONS IN NEUTRON ACTIVATION ANALYSIS**
F. Girardi, G. Guzzi, and J. Pauly 1965 317 p refs
(EUR-1898.e) CFSTI: HC $7.00/MF $1.75

This handbook enables one to determine whether an analytical problem can be solved by activation analysis or not, and how it can be solved. All the data which are necessary to calculate the sensitivity under different experimental conditions are assembled for most elements. Tables present sensitivity as a function of neutron flux, irradiation time, and decay time. Author (NSA)

**N66-13904#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

**EFFECT OF THE MODERATING-MEDIUM TEMPERATURE ON THE SPACE-ENERGY DISTRIBUTION OF NEUTRON FLUX [VLIYANIE TEMPERATURY ZAMEDLYAYUSHCHEI SREDY NA PROSTRANSTVENNO-ENERGETICHESKOE RASPREDELENIE POTOKOV NEITRONOV]**

A. N. Isaev and Ya. F. Chernilin 1964 13 p refs In RUSSIAN

(IAE-723) CFSTI: HC $1.00/MF $0.50

The possibility of increasing the neutron flux in the energy interval 0.1 to 0.5 eV by modifying the neutron energy spectrum and by changing the temperature of the reactor reflector is estimated. The analysis begins with an estimate of the influence of the variation of the temperature and the energy distribution of neutron fluxes in an infinite moderating medium without absorption of neutrons during the course of moderation. Such a neutron spectrum can be produced in the reactor with sufficiently thick reflector and small absorption cross section. In the next step it is assumed that the neutron spectrum of the reaction is such that the slowing-down neutrons have a Fermi distribution and the thermal neutrons have a Maxwellian distribution. The transition between the Fermi and the Maxwell spectra occurs in some energy region in which the neutron spectrum differs somewhat from Maxwellian. The results show that when the reflector temperature is increased from 350 to 1700° K the flux of the 0.2 to 0.6 eV neutrons increases 100 times. Corrections are introduced to allow for the neutron distribution in actual reactors (type IRT and type SM). The results confirm the appreciable increase in the integral flux of thermal neutrons resulting from the increase in the reflector temperature. Author (NSA)

**N66-13906#** California Univ., Berkeley. Lawrence Radiation Lab.

**HEAVY-PARTICLE STUDIES WITH SILICON DETECTORS**

Mudundi R. Raju 20 Aug. 1965 22 p refs Presented at Workshop Conf. on Space Radiation Biol., Berkeley, Calif., 7–10 Sep. 1965

(Contract W-7405-ENG-48)

(UCRL-16354; Conf-650924-3) CFSTI: HC $1.00/MF $0.50

The response of lithium-drifted silicon semiconductor detectors to alpha and proton beams, and the intermediate energies obtained by placing absorbing materials in the path of the primary beam were studied. The energy distribution at the Bragg peak positions of 910-Mev alpha beam and 49-Mev proton beam is measured in order to evaluate the linear energy transfer distribution at the Bragg peak. NSA

**N66-13909#** California Univ., Berkeley. Lawrence Radiation Lab.

**THEORETICAL ALPHA DECAY RATES OF DEFORMED NUCLEI**

John Kenneth Poggenburg, Jr. (Ph.D. Thesis) Aug. 1965 207 p refs

(Contract W-7405-ENG-48)

(UCRL-16187) CFSTI: HC $6.00/MF $1.25

The shell-model theory of alpha decay developed by Mang is summarized. The calculation of the alpha formation entails the use of the pairing-force wave functions of superconductivity theory, and their calculation with a delta-force approximation. The penetration of the alpha particle through the anisotropic potential barrier is considered in detail. The approximate treatment of Fröman is studied, and the results clearly justify the method. The particular features of the potential barrier are examined in terms of the WKB expression for barrier transmission. The Woods-Saxon potential $V = -74/(1 + \exp[(r - 1.17A^{1/3} - 1.6)/(a)])$ is chosen after a survey of recent optical model analyses of alpha scattering experiments. The Woods-Saxon potential results in penetrability factors that are ≈45% lower than those calculated with the Igo potential. Modification of the Coulomb potential has little effect on the penetrability. Extensive numerical calculations are given. The theory gives resonable agreement with experiment, and has provided a clear example of its value in the analysis of the alpha decay of $^{241}Am$. The calculations predict relative amplitudes and phases of importance in interpretation of angular correlation experiments. They also predict the 1-wave mixing in the transition to final states of odd-mass nuclei. Comparisons of theoretical and experimental transition rates indicate the nature of the errors in the calculations. Suggestions are given for future improvement. Author (NSA)

**N66-13912#** European Atomic Energy Community, Brussels (Belgium).

**MODULAR COUNTING SYSTEM IN THE ELECTRONIC SECTION [SISTEMA MODULARE DI CONTEGGIO DELLA SEZIONE ELETTRONICA]**

C. Colombo and L. Stanchi Jun. 1965 14 p In ITALIAN

(EUR-2444.i) CFSTI: HC $1.00/MF $0.50

The modular counting system used in nuclear detection measurement is briefly described. The instruments are built according to Esone System; they are designed with the aim to allow many different connections for the particular experiments in a very general way. Some types of lay-out are shown and the main characteristics of all the units are given.

Author (NSA)

**N66-13914#** California Univ., Berkeley. Lawrence Radiation Lab.

**NEUTRON SPECTROSCOPY BY THE USE OF NUCLEAR STARS FROM 20 TO 300 MEV**

Rene Remy (M.S. Thesis) 17 Aug. 1965 69 p refs

(Contract W-7405-ENG-48)

(UCRL-16325) CFSTI: HC $3.00/MF $0.75

Stars produced in emulsion by incident neutrons of known average energy ($E_n$) were used to obtain the average visible energy released per star ($\bar{E}_v$) as a function of $E_n$. The different neutron average incident energies were 20, 100, 160, 220, and 300 Mev. Although a good discrimination was obtained for $\bar{E}_v$ as a function of $E_n$, real values of $\bar{E}_v$ depend strongly on the validity of one of the working assumptions (average kinetic energy of grey prongs is independent of neutron incident energy). It was found that a much simpler method could be used to reach the same goal—the average number of grey prongs per star offers, in that range of neutron incident energy, a very good discrimination among the different $E_n$'s. So the use of a simplified method, which consists of counting the number of stars together with the number of grey prongs, should provide a simple way to obtain the average incident neutron energy for an unknown bombarding neutron spectrum in the range 20 to 300 Mev.

Author (NSA)

**N66-13915#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

**LEPTONIC DECAYS OF BARYONS IN THE UNIVERSAL V-A THEORY [LEPTONNYE RASPADY BARIONOV V UNIVERSAL'NOI V-A-TEORII]**

O. G. Bokov, Van Hieu Nguyen, K. V. Rerikh, A. A. Khelashvili, and A. N. Tavkhelidze 1965 20 p refs In RUSSIAN
(JINR-P-2278) CFSTI: HC $1.00/MF $0.50

In the framework of the universal V-A theory of weak interactions the leptonic decays of baryons are systematically studied. Expressions are obtained for the decay probability, the angular correlation, the energy spectra of leptons and recoil baryons, the asymmetry parameters in the angular distribution of leptons and recoil baryons by the decay of polarized baryons. The contributions from all possible form-factors were considered with account of their linear dependence on the momentum transfer. Author (NSA)

**N66-13924#** Oak Ridge National Lab., Tenn.
**COLLIMATORS FOR LOW-ENERGY GAMMA RAYS**
C. Craig Harris [1964] 5 p refs Presented at the Symp. on Nucl. Med., Philadelphia
(Contract W-7405-ENG-26)
(ORNL-P-1545; CONF-650313-4) CFSTI: HC $1.00/MF $0.50

The design of collimators for low gamma energies, particularly for energies below 160 kev, is briefly discussed, together with difficulties in the construction of such collimators. NSA

**N66-13937#** California Univ., Berkeley. Lawrence Radiation Lab.
**NEUTRON SPECTRA FROM AN ORGANIC SCINTILLATOR**
Willis R. Young (Ph.D. Thesis) Jun. 1965 80 p refs
(Contract W-7405-ENG-48)
(UCRL-16149)

The theoretical response of an organic scintillator to fast neutrons is developed in a general way. The general expressions are simplified by a simple model which allows a fast neutron as many as two n-p reactions before it leaves the system [double scattering model]. This results in an integral equation which expresses the proton recoil distribution as a function of incident neutron flux. A program code WILAG-3 is discussed which solves for the neutron flux from the double scattering model for a given proton recoil distribution. Neutron spectra derived from this model show significant improvement over spectra derived using a single scattering model. The resolution of an organic scintillator for 14 MeV neutrons as a function of size is measured and compared for both the single and double scattering models. The neutron spectra of $Pu^{239}Be$, PoBe, $Pu^{238}B$, and PoMF as derived from both models are presented. Author

**N66-13939#** Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.
**REPORT OF ACTIVITY, 15 OCTOBER 1964–14 APRIL 1965 [RAPPORT D'ACTIVITE, 15 OCTOBRE 1964–15 AVRIL 1965]**
May 1965 89 p In FRENCH
(LAL-1136) CFSTI: HC $3.00/MF $0.75

The modification and utilization of the accelerator are summarized, together with research progress on nucleon physics, nuclear spectroscopy, pion physics, and storage rings. Development of storage rings and associated experimental equipment and radiation control are also reported. NSA

**N66-13943#** Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
**MEASUREMENT OF THE BETA SPECTRUM Y-90 [MESSUNG DES BETASPEKTRUMS VON Y-90]**
Peter Riehs [1965] 7 p refs In GERMAN; ENGLISH Summary Submitted for Publication
(SGAE-PH-23) CFSTI: HC $1.00/MF $0.50

The beta-spectrum of Y-90 was measured by means of intermediate image beta-ray spectrometry and compared with the theoretical unique-first forbidden spectrum form. A factor $C(1+aW)$ with $a = (-0.0066 \pm 0.0013)/m_e c^2$ fits the deviation from the theoretical form. The endpoint energy of the spectrum was determined to be 2280±5 KeV. Author

**N66-13947#** Oak Ridge National Lab., Tenn.
**HIGH RESOLUTION MEASUREMENTS OF GAMMA RAYS FROM THERMAL AND RESONANCE NEUTRON CAPTURE IN $^{117}Sn$, $^{118}Sn$ AND $^{120}Sn$**
J. A. Harvey and G. G. Slaughter 1965 6 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1353; Conf-650706-9) CFSTI: HC $1.00/MF $0.50

High resolution measurements of the gamma ray spectra from thermal and resonance neutron capture in $^{117}Sn$, $^{118}Sn$, and $^{120}Sn$ were made with a lithium-drifted germanium detector. The energies and intensities of the gamma rays from neutron capture in $^{117,118,120}Sn$ are tabulated. NSA

**N66-13964#** California Inst. of Tech., Pasadena.
**APPROXIMATE SYMMETRY AND THE ALGEBRA OF CURRENT COMPONENTS**
Roger F. Dashen and Murray Gell-Mann May 1965 14 p refs
(Contract AT(11-1)-68)
(CALT-68-36) CFSTI: HC $1.00/MF $0.50

A probability-conserving theoretical analysis of the approximate symmetries of hadrons is presented, including the generalization of U(6) symmetry and its application to moving hadrons. NSA

**N66-14033#** Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
**CALCULATED PHOTOIONIZATION CROSS SECTION OF HELIUM AND THE ALKALAIS**
E. J. Mc Guire Jul. 1965 42 p refs
(Contract Nonr-401(37))
(TR-13; AD-620939) CFSTI: HC $2.00/MF $0.50

The use of the model orbitals for the active electron orbital in the continuum leads to cross sections is shown to be in good agreement (except lithium) with experiment. However for systems in their ground state it is generally necessary to perform a numerical integration. TAB

**N66-14038#** Atomic Energy Establishment, Winfrith (England). Control and Instrumentation Div.
**THE NEUTRON ACTIVATION OF TITANIUM AND ITS INFLUENCE ON IONISATION CHAMBER DESIGN**
A. Goodings and P. R. Paull Oct. 1964 36 p refs
(AEEW-M-470)

The neutron activation aspect of commercially available Titanium has been examined experimentally and it is concluded that the metal is, in some ways, superior to Aluminum for wide range ionization chamber construction. Similar tests on a Titanium/Aluminium/Tin alloy and on low manganese content stainless steel are also reported. Author

**N66-14079#** Atomic Energy of Canada, Ltd., Chalk River (Ontario). Physics Div.
**PROGRESS REPORT, APRIL 1–JUNE 30, 1965. PART 3: PHYSICS DIVISION**
L. G. Elliott et al [1965] 63 p refs
(PR-P-66; AECL-2501) CFSTI: HC $3.00/MF $0.75

Research activities are reported in the areas of general physics, as well as for the more specialized branches of nuclear physics, neutron physics, space physics, and theoretical physics. Summaries on the developments and results of some 50 studies are included, covering such topics as fission neutron; neutron production, yields, and scattering; solid state radiation detectors; gas counters; spectrometers; $SU_3$ model calculations; charged particles; spherical harmonics calculations; and cosmic ray monitors. M.G.J.

N66-14146# Library of Congress, Washington, D. C. Aerospace Information Div.
**CHARGE-CHANGING COLLISIONS IN GASES: A DESCRIPTIVE BIBLIOGRAPHY, PART I**
6 Feb. 1964 74 p refs
(AID-U-64-4, Pt. I; AD-622232)

A bibliography is given of charge-changing collisions in gases. Eighty-seven articles are listed and their abstracts are included. TAB

N66-14186# California Univ., La Jolla.
**APPLICATION OF A SELF-CONSISTENT SCHEME INCLUDING EXCHANGE AND CORRELATION EFFECTS TO ATOMS**
B. Y. Tong and L. J. Sham 27 Oct. 1965 19 p refs
(Contract Nonr-2216-(11))
(TR-35; AD-623579) CFSTI: HC $1.00/MF $0.50

Self-consistent schemes including approximations to exchange and correlation proposed by Kohn and Sham are applied to computing atomic energies and densities. These quantities, with and without the correlation correction, are obtained and compared with the results of calculations using the Slater exchange hole or the Hartree-Fock method and with experimental values. The present method, without correlation, gives slightly better results for energies and substantially better results for densities than Slater's method. This was anticipated in the general theory. The correlation corrections of the present scheme are not very good, presumably due to the fact that the electronic density in atoms has too rapid a spatial variation. Author (TAB)

N66-14213# Osterreichische Studiengesellschaft für Atomenergie G.M.B.H., Seibersdorf (Austria).
**DETERMINATION OF THERMAL AND RESONANT FISSION PRODUCTS OF Cs-136, Cs-137, Ba-140, Ru-103 AND Ru-106 ON U-233- AND U-235 PROBLEM [BESTIMMUNG DER THERMISCHEN UND EPITHERMISCHEN SPALTAUSBEUTEN VON Cs-136, Cs-137, Ba-140, Ru-103 UND Ru-106 AN U-233- UND U-235- PROBLEM]**
L. Balcarczyk, P. Keratschev, and E. Lanzel [1965] 11 p refs
In GERMAN
(SGAE-PH-22/1965) CFSTI: HC $1.00/MF $0.50

Qhen measuring comparison values of fission efficiency for Cs-137, Cs-136, Ba-140, Ru-103, and Ru-106 on U-233 and U-235 products, for their resonant and thermal neutrons, no difference was determined. Since the self-absorption of uranium within resonance range single fission efficiencies could not have been determined with absolute certainty, the Ba-140 has been used as a reference standard, and anomalous values were received for Cs-136 (U-235 fission), Cs-136, Ru-103, and Ru-106 (U-233-fission). Transl. by G.W.

N66-14254# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**A HELIX LINEAR ACCELERATOR FOR ELECTRONS AS A MODEL FOR A PROTON ACCELERATOR**
Horst Klein Sep. 1965 24 p Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 18, no. 3, 1964 p 143-149
(AECL-2287) CFSTI: HC $1.00/MF $0.50

An investigation was made to determine how far the theory is applicable in describing a properly functioning helix linear accelerator, and what accelerator properties are to be expected. A 3 meter long accelerator was designed and built for the acceleration of protons from 6.8 MeV. For practical reasons, electrons instead of protons were accelerated over the same range of speed, 3700 eV to 5660 eV. The acceptance region and energy distribution of the accelerated particles were experimentally investigated in their dependence on the injection energy, frequency, and rf power (and hence equilibrium phase). It was shown that the accelerator was always uncritical in its operation: changing the frequency by 10% and the injection energy by 5% caused only small changes in the shape of the energy spectra. Comparison between the measured energy spectra and those calculated on the basis of the phase oscillations give a good agreement in the form and position on the energy scale, as well as in the acceptance region. C.T.C.

N66-14258*# Denver Univ., Colo. Dept. of Physics.
**LOW ENERGY IONIZATION OF ARGON ATOMS BY ARGON ATOMS**
Howard C. Hayden and Robert C. Amme Jul. 1965 8 p refs Submitted for Publication
(Grant NsG-392)
(NASA-CR-69016) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Total cross section is reported for the production of electrons by collisions between neutral argon atoms. At low energies a marked structure is observed which suggests a series of competing processes. This could be excitation of metastable states in either the atom or ion, or possibly both. An alternative explanation could be that of energy resonances in the production of autoionizing states. The method employs the use of a neutral argon beam formed by symmetric charge transfer. The measurements are carried out over the energy range of 30 eV (just below the ionization threshold for electron production in ground state argon atom collisions) to 2900 eV. C.T.C.

N66-14268# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
**THE MASS SPECTROSCOPY OF VERY SMALL AMOUNTS OF SUBSTANCES IN NUCLEAR PHYSICS AND ISOTOPE COSMOLOGY**
H. Hintenberger London, HMSO, 1965 36 p refs Transl. into ENGLISH from Naturwiss. (W. Berlin), v. 51, no. 20, 1964 p 473-480 and v. 51, no. 21, 1964 p 497-503
(AERE-TRANS-1028) HMSO: 5s

A discussion is given of mass spectroscopy as applied to detecting small amounts of substances in nuclear physics and isotope cosmology. Mass spectroscopic detection of a substance is performed in three stages: the production of an ion beam in vacuum, splitting of the ion beam according to the mass of the various particles, and ion detection. A general indication is given of the methods available in each of the three stages to achieve the highest possible detection efficiency. In the nuclear physics area mass spectroscopic detection is examined relative to the investigation of stable and radioactive products of nuclear reactions. For isotope cosmology (an extension of isotope geology) mass spectroscopy is discussed for examining samples of extraterrestrial matter. C.T.C.

# 25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

**N66-13541#** Polish Academy of Sciences, Warsaw.
**THE INTERACTION OF THE FAST PLASMOIDS WITH THE BARRIER OF THE ALTERNATING MAGNETIC FIELD [ODDZIALYWANIE SZYBKICH PLASMOIDOW Z BARIERA ZMIENNEGO POLA MAGNETYCZNEGO]**
C. Khashchebki 1965 15 p refs In RUSSIAN; ENGLISH summary
(Rept.-631/1XA/PR) CFSTI: HC $1.00/MF $0.50

The effects of the interaction of the fast plasmoids with the pulse high frequency magnetic field barrier were investigated. Depending on the phase and the magnetic field amplitude full reflection, partical penetration, focusing and acceleration of the plasmoids were observed. Author

**N66-13563*#** Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
**AN ANNOTATED BIBLIOGRAPHY ON MOTION OF CHARGED PARTICLES IN MAGNETIC FIELDS AND MAGNETIC SHIELDING AGAINST SPACE RADIATION**
Perry F. Mc Donald Nov. 1965 44 p refs
(Contract NAS8-20166)
(NASA-CR-68657; R-161) CFSTI: HC $2.00/MF $0.50 CSCL 20I

This annotated bibliography on the theory of charged particle motion in magnetic fields and the shielding against charged particle radiation using magnetic fields in divided into five sections: (1) general references on charged particle motion and cosmic rays, (2) motion of untrapped particles in magnetic fields, (3) motion of trapped particles in magnetic fields, (4) ring currents in the magnetosphere, and (5) space radiation shielding using magnetic and electric fields. It should be helpful to those interested in the interaction of cosmic rays and energetic solar particles with the geomagnetic field and those interested in the active methods of shielding against space radiation. Author

**N66-13591#** Atomic Weapons Research Establishment, Aldermaston (England).
**A LOW ENERGY SPREAD NEGATIVE ION RF SOURCE**
G. Garner and D. Swann London, HMSO, Jul. 1965 11 p refs
(AWRE-NR-1/65) HMSO: 1s 9d

This report describes a negative ion rf source with an ion beam energy spread approaching that of sources of the duoplasmatron type. It has a better performance for both pulsed and nonpulsed operation than the negative ion rf source previously used on the tandem accelerator. Author

**N66-13639*#** General Applied Science Labs., Inc., Westbury, N. Y.
**DEVELOPMENT OF AN ELECTRON DENSITY PROBE Final Report, 22 Jun. 1964–22 Mar. 1965**
M. Abele, R. W. Byrne, and H. Medecki 9 Apr. 1965 152 p refs
(Contract NAS5-3929)
(NASA-CR-68500; GASL-TR-527) CFSTI: HC $1.00/MF $1.00 CSCL 20I

The development of electron density probes to perform measurements in flow fields similar to those estimated to exist in the local flow surrounding the Apollo spacecraft during reentry at altitudes between 350 000 and 150 000 feet is described. Two operational, internal cavity, electron density probes were developed. One of these probes operates with a 10-cm wavelength and measures electron densities in the range of $10^8$ to $10^{11}$ e/cm$^3$. The other probe operates with a 3-cm wavelength and measures electron densities in the range of $10^9$ to $10^{12}$ e/cm$^3$. Theoretical investigations indicated that by using other techniques, such as the external cavity and the low phase velocity structure, it should be possible to extend the upper limit of measurable electron densities to $10^{14}$ e/cm$^3$. R.R.D.

**N66-13652#** European Atomic Energy Community, Brussels (Belgium).
**NOTES ON LOW FREQUENCY PLASMA OSCILLATIONS (ANODE OSCILLATIONS AND FORCED RELAXATION OSCILLATIONS)**
J. C. Terlouw (Stichting voor Fundamenteel Onderzoek der Materie) Apr. 1965 17 p refs *Its* Rijnhuizen Rept.-65-24
(NP-15445) CFSTI: HC $1.00/MF $0.50

A study of cesium plasma instabilities in front of the anode in a gas discharge is presented. The following discussions are presented; the anode fall in potential periodicity of the anode oscillations, influence of anode cooling, relaxation oscillations, and the cathode region during a relaxation oscillation. NSA

**N66-13676#** Sheffield Univ. (England). Dept. of Fuel Technology and Chemical Engineering.
**METHODS OF ELECTROMAGNETIC INDUCTION APPLIED TO THE MEASUREMENT OF SUPERSONIC VELOCITIES IN SHOCK TUNNELS**
R. J. Parsons and M. A. Patrick Feb. 1965 10 p ref *Its* Admin. Rept.-1
(Grant AF-EORR-65-23)
(AFOSR-65-1327; AD-622665) CFSTI: HC $1.00/MF $0.50

A technique based on electromagnetic induction is proposed to measure the velocity of the flow in a hypersonic shock tunnel. The expanded flow in the tunnel test section has a sufficiently high conductivity level to allow the generation of an MHD voltage in the presence of a magnetic field, which can then be used to indicate the flow velocity. To overcome charge effects on the electrodes, the magnetohydrodynamic voltage from such a device should be of the order of 100 v. For a true open circuit reading the input impednece of the external circuit should be very high. Author (TAB)

**N66-13743#** Microwave Associates, Inc., Burlington, Mass.
**INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS Eleventh Quarterly Progress Report, 16 May–15 Aug. 1965**
H. S. Maddix [1965] 31 p refs
(Contract DA-36-039-AMC-00097(E))
(Rept.-11; AD-622683) CFSTI: HC $2.00/MF $0.50

Clean-up of mixtures of argon, ammonia, water vapor, hydrogen, and air in a TR tube were investigated with the aid of a mass spectrometer. The following types of cleanup were observed over a 20° to 300° C temperature range: (1) initial physical and chemical adsorption, (2) clean-up due to a glow discharge at a stainless steel electrode, (3) cleanup due to a 1 watt RF discharge between nickel cones,and (4) clean-up due to a 10 watt RF discharge at a window composed of 7070 glass sealed to a kovar iris. Clean-up of argon was small compared to clean-up observed for the remaining gases. Initial physisorption of ammonia and water vapor occurred compared

to initial chemisorption of oxygen in an air-argon mixture. The discharges produced dissociation of $NH_3$ and $H_2O$ followed by diffusion controlled clean-up of $H_2$. In air the discharges caused chemisorption of oxygen. Diffusion controlled thermal recovery of $H_2$ was observed following termination of the 10 watt $H_2$ and $NH_3$ discharges. No thermal recovery occurred following $H_2O$ and air discharges in which $O_2$ was chemisorbed. The relationship between the role of dissociative attachment of electrons to reduce signal recovery time and the subsequent clean-up of the dissociation products is discussed. Author (TAB)

**N66-13923#** Oak Ridge National Lab., Tenn.
**ION CYCLOTRON HARMONIC SPECTRUM GENERATED IN AN ENERGETIC ION PLASMA**
P. R. Bell, G. G. Kelly, N. H. Lazar, and R. F. Stratton [1965] 16 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1576; CONF-650806-9) CFSTI: HC $1.00/MF $0.50

Measurements were made of the electric and magnetic fields produced in a plasma of $3 \times 10^9$ ions/cc density with a mean ion energy of about 700 kev. Spectral analysis of the signals show oscillations at the ion cyclotron frequency and its harmonics up to at least the 70th harmonic. The intensity ratio to an electrostatic probe is less than 30 db between the 3rd harmonic (usually the strongest) and the 60th harmonic. The plasma is contained in a nearly uniform magnetic field between mirror coils spaced 4 meters apart. As a result of the strong anisotropy of the particle velocities, most of the plasma is further restricted axially by a very small magnetic mirror to a region $\sim \pm 30$ cm about the midplane. The plasma diameter is 30 cm. The electric field is strongly absorbed by the plasmas. Probes axially spaced by more than 10 cm show almost complete lack of phase correlation, although the spectral distributions are not very different. When the plasma decays, some of the fields persist for density reductions of more than an order of magnitude. In particular, the fundamental, whose width at full density is $\sim 150$ kc ($f = 18.3$ Mc), lasts for several seconds and shows a frequency shift of $\sim 50$ kc as well. Author (NSA)

**N66-13949#** Princeton Univ., N. J. Plasma Physics Lab.
**INVESTIGATION OF THE EQUILIBRIUM OF A TOROIDAL PLASMA IN THE MODEL C STELLERATOR**
K. M. Young, S. Yoshikawa, and R. M. Sinclair Sep. 1965 32 p refs
(Contract AT(30-1)-1238)
(MATT-297)

The circular conducting metal limiter provided equilibrium for a toroidal magnetically confined plasma is shown to be due to a short circuiting action between the top and bottom of the plasma. The experiments use a limiter made of conducting segments which can be connected or disconnected. With no connection between the segments and in the absence of both an external rotational transform and a transverse magnetic field, large voltages are observed between the top and bottom segments indicating a large outward velocity for the plasma. With the segments connected so current can flow between them, the expanding forces of the plasma produce a current to the limiter plates. The magnitude of the limiter current was observed to change with the plasma parameters in close accordance with theory. For low ohmic heating currents ($< 10 A/cm^2$), it is shown that an external helical transform cannot provide equilibrium because of the high plasma resistivity. C.T.C.

**N66-13976#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**FORMATION OF COMPRESSION WAVES IN A COLLISION-FREE PLASMA UNDER MAGNETIC PRESSURE**
K. T. Yen and Paul Gordon Nov. 1965 27 p refs Presented at the 7th Ann. Meeting of the Plasma Phys. Sect., Am. Phys. Soc., Nov. 1965
(R65SD58)

The time development of compression waves produced in a collision-free magnetic plasma by a magnetic field applied at the plasma boundary is studied by numerical integration. Coupled hydrodynamic and Maxwell equations are used. This initial-value problem has been solved in a mathematically rigorous manner with the displacement current retained in the Maxwell equation. Details of the formation of the waves and profiles of various physical quantities have been obtained from the IBM-7094 computer. The disturbances in the form of maxima of these quantities are found to propagate with different speeds. The plasma density at the boundary decreases with time, and the time for it to drop to nearly zero depends on the ratio between the initial values of the gas and magnetic pressures. Author

**N66-13986#** Columbia Univ., New York. Dept. of Electrical Enginnering.
**OBSERVATION OF NON-QUASISTATIC PLASMA SURFACE WAVES Scientific Report No. 83**
Victor L. Granatstein and S. Perry Schlesinger 25 Jun. 1965 22 p refs
(Contract AF 19(628)-2461)
(CU-12-65-AF-2461-EE; AFCRL-65-556; AD-623122) CFSTI: HC $1.00/MF $0.50

Surface waves have been launched from a waveguide onto a glass-clad plasma column of moderate size ($2\pi R$ = free space wavelength), in order to test the validity of quasistatic analysis when the small column condition ($2\pi R << $ free space wavelength) is not satisfied. Resonances were observed in an open microwave cavity, and dispersion of both the circularly-symmetric surface wave and the dipole surface wave has been determined from experimented data. The two waves exhibit regions of backward-wave and forward-wave propagation. The observed positive slope of the dipole mode dispersion curve near signal frequency/axial propagation constant = c is contrary to the predictions of quasistatic analysis, and is shown to agree quantitatively with the results of a more rigorous analysis. Author (TAB)

**N66-14083#** Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**STUDY OF THE EQUATIONS OF PERCUS AND YEVICK, OF HYPERCHAIN AND OF BORN AND GREEN IN THE CASE OF CLASSICAL FLUIDS [ETUDE DES EQUATIONS DE PERCUS ET YEVICK, D'HYPERCHAINE ET DE BORN ET GREEN DANS LE CAS DES FLUIDES CLASSIQUES]**
Dominique Levesque Oct. 1965 36 p refs In FRENCH
(TH/111) CFSTI: HC $2.00/MF $0.50

The equation of state for classical fluids is derived independently from each of three quantum mechanical expressions: (1) the equation of Percus and Yevick (PY); (2) the equation of Born and Green (BG); and (3) "hyperchain" equation (HCN). Internal coherence is demonstrated for all three derivations, which are compared with each other and with earlier derivations to determine their exactitude over a range of situations. The PY and HNC equations of state give similar results which compare favorably with those of previous works. The methods are given for all three derivations, and tables of results for earlier equations are included. Transl. by D.T.

**N66-14163#** United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
**THE EFFECT OF A FINITE TEMPERATURE ON THE ELECTRON CYCLOTRON RESONANCE INSTABILITY**
J. G. Cordey Jun. 1965 15 p refs
(CLM-R-44) HMSO: 3s

The effect of Landau damping on the electron cyclotron resonance instability is investigated for a Burt-Harris type model of a confined plasma cylinder. The axis of the cylindrical shell of plasma lies along a uniform magnetic field. The plasma is assumed to consist of three groups of particles, a group of electrons which move in concentric Larmor orbits about the axis of the cylinder, another group of electrons with no component of velocity perpendicular to the magnetic field and a group of ions also with no component of velocity perpendicular to the magnetic field. A dispersion relation is then deduced, for electrostatic perturbations of this system. Analytical and numerical results are presented for the stability criteria and growth rates of the instability. Author

**N66-14200#** Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
**DEVELOPMENT OF EXPERIMENTAL GAS DISCHARGE DISPLAY Quarterly Progress Report No. 8, 24 Jun.–24 Sep. 1965**
Oct. 1965 15 p
(Contract NObsr-89201)
(GRR-65-1109; AD-623597) CFSTI: HC $1.00/MF $0.50

Progress is reported on a program to develop an experimental prototype gas discharge display panel with internal storage capability. The panel will consist of an X–Y matrix of individual gas cells, each of which can be selected and fired by the application of a short triggering pulse. The objectives are to develop a display with high light output, low firing and distribution voltages, and a configuration such that eventual production panels can be fabricated at the lowest possible cost per unit cell. TAB

**N66-14262#** International Union of Pure and Applied Chemistry, Basle (Switzerland).
**HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS Bibliography**
L. Brewer (Calif. Univ., Berkeley) 30 Sep. 1965 20 p refs
(Rept.-16)

A bibliography is given on the high temperature chemistry and physics of gases and gas-condensed phase reactions. Spectroscopy of interest to high temperature chemistry is included. C.T.C.

**N66-14321#** Sylvania Electric Products, Inc., Waltham, Mass.
**SLOT ADMITTANCE FOR COMPRESSIBLE PLASMA LAYERS**
Janis Galejs Sep. 1965 39 p refs
(Contract AF 19(628)-2410)
(AFCRL-65-717; AD-623407) CFSTI: HC $2.00/MF $0.50

The admittance of a waveguide is calculated for radiation into a general two layer compressible plasma which is further specialized to represent a plasma sheath and also an ion sheath in the presence of a plasma halfspace. The antenna admittance is related by integrals to the electric fields in the waveguide aperture, which are assumed to be a sum of the principal waveguide mode and of surface wave fields which are supported in this plasma geometry. The compressibility of plasma has the largest effect on the slot admittance when the slot width is equal to an odd number of half wavelengths of surface waves, but significant changes occur only if the relative dielectric constant of the plasma is less than 0.2, and the ratio of the free space velocity of electromagnetic waves to the acoustic velocity is less than 300. Plasma losses and the presence of an ion sheath tend to lessen the compressibility effects. Author (TAB)

# 26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

**N66-13342** Library of Congress, Washington, D. C. Aerospace Technology Div.
**INDIRECT FREE-CARRIER-ASSISTED ABSORPTION AND RECOMBINATION AND THE POSSIBILITY OF NEGATIVE ABSORPTION BY SUCH A MECHANISM**
Charles Shishkevish *In its* Foreign Sci. Bull., Vol. 1, No. 10, Oct. 1965 p 6–13 refs (See N66-13340 04-34)

In a recent article S. M. Ryvkin proposed a new mechanism for indirect optical transitions, i.e., indirect absorption or emission of photons, which occur as a result of interaction with the free carriers. In two subsequent papers Ryvkin in collaboration with others analyzed the mechanism and discussed criteria for attaining negative absorption by means of indirect free-carrier transitions. Ryvkin's latest paper, which is available in English, reviews the first three articles. Analysis of the preliminary experimental data on recombination radiation from Ge n-i-p diodes at liquid nitrogen temperature shows that the observed longwave tail can probably be attributed to free-carrier-assisted transitions. Author

**N66-13347** Library of Congress, Washington, D. C. Aerospace Technology Div.
**CRYSTAL STRUCTURE OF LANTHANUM DITELLURIDE (USSR)**
*In its* Foreign Sci. Bull., Vol. 1, No. 10, Oct. 1965 p 39–40 refs (See N66-13340 04-34)

The unit cell structure of $LaTe_2$ was established using Patterson projections of interatomic vectors and one- or two-dimensional projections of electron density. The atomic coordinates, coordination numbers, and interatomic distances were established. The existence of $Te_I$ and $Te_{II}$ was indicated and a similarity to the $Cu_2Sb$ was found. R.C.M.

**N66-13455#** AVCO-Everett Research Lab., Everett, Mass.
**THE BEHAVIOR OF SUPERCONDUCTING COIL SUBJECTED TO STEADY LOCAL HEATING WITHIN THE WINDINGS**
Z. J. J. Stekly Aug. 1965 36 p refs Ballistic Systems Div., Norton AFB, Calif.
(Contract AF 04(694)-414)
(AVCO-Everett Res. Rept.-225; BSD-TR-65-429; AD-470543)

The steady state heat conduction equation in a non-isotropic solid is solved for the relationship between local heat input, the size of the heated region and the Joule heating in the resultant normal region. The results are used to derive the steady terminal voltage-current characteristics of a super conducting coil with heat generation within the windings. These terminal characteristics exhibit both a positive as well as a negative slope of the voltage versus current curve. A map of the expected behavior of a current carrying superconducting coil with

heat generation in the windings shows that the coil can do one of three things: (1) remain fully superconducting; (2) operate in a stable manner with a non-propagating normal region; (3) go fully normal (quench). The analytical results are compared with measurements taken with a non-inductive and an inductive coil. The measured terminal characteristics as well as overall coil behavior agreed well with the results derived analytically. Author (TAB)

**N66-13523#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**TEMPERATURE DEPENDENCE OF THE RATE OF SPIN-WAVE DAMPING**

G. A. Petrakovskii, E. P. Naiden, and I. K. Pukhov [1964] 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 4, 1964 p 68–71

The temperature dependence of the ferromagnetic resonance line-width $\Delta H_k$ of single crystal ferrites is investigated to characterize the rate of spin-wave damping (relaxation). The method used for measuring $\Delta H_k$ is described and a block diagram of the experimental set-up is shown. The phenomenon of parametric excitation of spin waves by longitudinal microwave magnetic field is used for the experimental determination of $\Delta H_k$. Temperature measurements were made in the range from room (300° K) to the Curie point and were conducted on single-crystal yttrium and manganese ferrites. The sample diameters were 1.35 and 1.97 mm respectively and were magnetized in the 111 directions. Results are presented graphically. M.R.W.

**N66-13570*#** University of Southern Calif., Los Angeles. Dept. of Physics.

**VACUUM ULTRAVIOLET RADIATION AND SOLID STATE PHYSICS Semiannual Status Report No. 7, Period Ending 31 Aug. 1965**

G. L. Weissler 15 Oct. 1965 33 p refs

(Grant NsG-178-61)

(NASA-CR-68499) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Progress is reported on the determination of the index of refraction and the extinction coefficient for 45 separate barium surfaces and 2 silver surfaces, all deposited and maintained in a vacuum of about $5 \times 10^{-10}$ torr. Also, preliminary measurements of grating efficiencies down to 118 Å were made on the grazing incidence monochromator. Optical constants of surfaces and thin films were maintained in a conventional vacuum of $10^{-5}$ torr and measured at grazing incidence down to 100 Å. E.E.B.

**N66-13643*#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.

**RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRON AND PROTON RADIATION Progress Report, 15 Mar.–15 Sep. 1965**

John C. Correlli [1965] 91 p refs

(Grant NsG-290)

(NASA-CR-68567) CFSTI: HC $3.00/MF $0.75 CSCL 20L

Progress is reported for four projects dealing with damage to silicon and germanium from high energy electron and proton irradiation. Infrared spectroscopy using polarized light as well as stress alignment experiments on defects inducted in silicon by ≈ 45Mev electrons confirm that the 1.8 micron absorption band is caused by a divacancy effect; this divacancy is identified by evidence from annealing and dichroic ratio and symmetry studies. Following cold temperature irradiation with ≈ 48 Mev electrons, it is concluded that a defect band at 618 $cm^{-1}$ may be germanium A-center, a simple complex consisting of a substitutional oxygen coupled to a single vacancy similar to the radiation-induced-defect found in silicon. Experiments on germanium doped with antimony, arsenic, and indium conclude that there is a close correspondence between trapping levels and defect acceptors. For As and Sb, the dopant has no significant effect on the introduction of long lived traps. Marked differences were observed in defect energy levels produced and in annealing behaviors of germanium doped with oxygen and antimony, emphasizing the important role of dopant impurities. M.W.R.

**N66-13679#** Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

**SOLID STATE TECHNIQUES FOR MODULATING OPTICAL WAVES First Quarterly Report, 1 Apr.–1 Jul. 1965**

C. J. Peters [1965] 32 p refs

(Contract DA-28-043-AMC-01283(E))

(Q-5075-1; AD-622884) CFSTI: HC $2.00/MF $0.50

The first quarter of this project was devoted primarily to the selection of an optimum material for the construction of a wide bandwidth traveling wave optical modulator. Our conclusion from this survey is that the most promising materials for this purpose are KDP and KDA. The criteria applied in selecting the optimum electro-optic material comprised availability, microwave performance, machinability, and optical characteristics. The characteristics of availability and microwave performance essentially confine our attention to the isomorphs of KDP. Such materials as KTN, cuprous chloride, zinc sulfide, and so forth were not considered in detail. The first step in evaluating the various materials was to collect together all the data on material properties which are available in the literature. A few gaps in this data were filled by experimental measurements made in this laboratory. The dielectric constant for RDA and the thermal conductivity of RDA, KDA, and ADA were measured. Simultaneously with this measurement of the material properties, we composed a computer routine to calculate the microwave performance of a model which takes into account the electro-optic and the dielectric properties of the electro-optic material. Author (TAB)

**N66-13708#** Artiebolaget Atomenergi, Stockholm (Sweden).

**IMPROVEMENTS IN APPLIED GAMMA-RAY SPECTROMETRY WITH GERMANIUM SEMICONDUCTOR DETECTOR**

D. Brune, J. Dubois, and S. Hellström Jan. 1965 18 p refs

(AE-174) CFSTI: HC $1.00/MF $0.50

A germanium semiconductor detector has been used in four cases of applied gamma-ray spectrometry. In one case the weak-activity contribution of $Cs^{134}$ in $Cs^{137}$ standard sources has been determined. The second case concerns the determination of $K^{42}$ in samples of biological origin containing strong $Na^{24}$ activities. In the third case the $Nb^{94}$ and $Nb^{95}$ activities from neutron-irradiated niobium foils used in the dosimetry of high neutron fluxes with long exposure times have been completely resolved, and it has been possible to determine the ratio of the two activities with a high degree of accuracy. Finally, a $Zr^{95}$–$Nb^{95}$ source has been analysed in a similar way with respect to its radiochemical composition. The resolution obtained also made possible a determination of the branching ratio of the two gamma-transitions in $Zr^{95}$ and of the energies of the gamma-transitions of both nuclides. Author

**N66-13709#** Tyco Labs., Inc., Waltham, Mass.

**POWDER-DENSE THERMOELECTRIC MODULE. PHASE IV: SOLIDIFICATION OF THERMOELECTRIC MATERIALS UNDER THE INFLUENCE OF ULTRASONIC AGITATION Final Report**

Martin Weinstein May 1964 109 p refs
(Contract NObs-86015)
(AD-622393) CFSTI: HC $4.00/MF $0.75

A technique is described for preparing fine-grained PbTe, PbTe–SnTe, $Bi_2Te_3$, $Bi_2Te_3$–$Bi_2Se_3$, and $Bi_2Te_3$–$Sb_2Te_3$ by ultrasonic agitation of a solidifying melt. Material prepared by this technique is dense and chemically homogeneous. The thermoelectric efficiency factors of ultrasonically prepared PbTe and PbTe–SnTe compare very favorably with that of material prepared by other techniques. The ultrasonically prepared $Bi_2Te_3$ and $Bi_2Te_3$ alloys normally possess lower thermoelectric-efficiency factors than material prepared by directional solidification. The lower thermoelectric efficiency of the (UA) material is associated with the anisotropic behavior of the electrical properties in $Bi_2Te_3$ layerlike structures. Comparison of compressive-flow curves for PbTe and SnTe–PbTe solid solutions prepared by various techniques shows that the ultrasonically prepared material has greatly superior ductility and strength. In the $Bi_2Te_3$ and $Bi_2Te_3$ alloy systems, the ultrasonic material shows higher compressive strengths than material prepared by directional solidification. The ductility of the $Bi_2Te_3$ and $Bi_2Te_3$ alloys prepared by ultrasonic agitation is essentially the same as that of material prepared by directional solidification. Preliminary results are reported on the Ge–Si solid solution system. TAB

**N66-13722#** Air Force Cambridge Research Labs., Bedford, Mass.
**DIRECT OBSERVATION OF DISLOCATIONS AND PLASTICITY IN MINERAL CRYSTALS WITH SPECIAL REFERENCE TO PLAGIOCLASE**
K. E. Seifert Jul. 1965 43 p refs *Its* Spec. Rept.-29
(AFCRL-65-502; AD-621365) CFSTI: HC $2.00/MF $0.50

The AFCRL mineral study determines deformational behavior in important rock-forming minerals as a function of their internal and external environment. Internal perfection of crystals is being determined by chemical analysis, thermoluminescence, optics, X-ray studies and by use of etching and the electron microscope to study dislocation density and pattern. External environment is being determined by experimentally deforming crystals under known conditions of temperature, pressure, rate of strain and total strain. In this manner crystal deformation can be used to help interpret the previous history of these minerals either singularly or as mixtures in rocks. Previous studies involving the application of the etch-pit method to minerals and the influence of dislocations on plasticity are reviewed. In particular the relationship of dislocations to twin gliding and translation gliding is discussed, with special reference to plagioclase.
Author (TAB)

**N66-13766#** Army Electronics Labs., Fort Monmouth, N. J.
**DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF FERROCENE SINGLE CRYSTALS ON DISLOCATIONS**
Claire Loscoe Jul. 1965 9 p refs
(ECOM-2619; AD-622496) CFSTI: HC $1.00/MF $0.50

Etch pits were obtained on the surfaces of ferrocene single crystals, which were grown from solution of benzene and ferrocene, by two methods: simple evaporation in air and, etching in methyl alcohol. For each sample, the etch pit density (N) which indicates the number of dislocations in the crystals, was determined on the (001) surface of the crystals, and the resistivity was measured in a direction perpendicular to this face. The resistivity is found to be greater for samples with greater etch pitch density, and may be expressed as resistivity = AN (3.3), where A is a constant.
Author (TAB)

**N66-13816#** Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.
**ELECTRO-OPTICAL MATRIX DISPLAY Fourth Quarterly Interim Development Report, 18 Jun.–18 Sep. 1965**
[1965] 16 p
(Contract NObsr-91199)
(Rept.-480-Q4; AD-622551) CFSTI: HC $1.00/MF $0.50

Preparation of RIS 1 films with low coercive force and good display properties is readily achieved, and continued efforts have been made toward further improvement of display element properties and reproducibility. The problem of immobilization of the bitter colloid in an unswitchable display pattern has been investigated by modifying the preparation of colloid dispersions, and by providing protective overlayers on the magnetic films. Recent non-aqueous suspensions in glycerine appear to be a solution to immobilization; other aqueous suspensions also show promising freedom from immobility over long periods. Protective coatings consisting of 3 layers of SiO of 800 A, total thickness, appear effective in protecting films against corrosion and immobilization. Continued refinement of seals, spacers, and filling techniques is in progress, although workable sealed modules can be readily made at the present state of development.
Author (TAB)

**N66-13895** Carnegie Inst. of Tech., Pittsburgh, Pa.
**INVESTIGATIONS IN SOLID STATE PHYSICS Final Report, 1 Apr. 1955–31 Jan. 1965**
S. A. Friedberg 9 Jul. 1965 11 p refs
(Contract Nonr-760(05))
(AD-620902) CFSTI: HC $1.00/MF $0.50

Principal results obtained during the period from April 1955 to January 1965 are summrized. Publications are listed in which these results are fully described. Some topics discussed are: Substances with the diamond lattice; Magnon contributions to heat transport; Systems of coupled paramagnetic ions; Transition metals and their alloys; Miscellaneous compounds.
TAB

**N66-13916#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
**ELECTROPHOTOGRAPHIC METHOD FOR DETERMINING THE LITHIUM DIFFUSION CONSTANT IN THE p-TYPE SILICON [ELEKTROFOTOGRAFICHESKII METOD OPREDELENIYA KOEFFITSIENTA DIFFUZII LITIYA V KREMNI p-TIPA]**
L. G. Yuskeselieva and A. S. Antonov [1965] 14 p refs In RUSSIAN
(JINR-P-2282) CFSTI: HC $1.00/MF $0.50

A method is proposed for determining the lithium diffusion constant in the p-type silicon. It is based on applications of electrophotographic developers and is efficient and simple.
Author (NSA)

**N66-13931#** Joint Publications Research Service, Washington, D. C.
**RELATIONSHIPS BETWEEN ZONAL AND DISCRETE ABSORPTION IN X-RAY SPECTRA OF ATOMS IN POLAR CRYSTALS**
L. N. Mazalov, E. Ye. Vaynshteyn, and V. G. Zyryanov 6 Dec. 1965 9 p refs Transl. into ENGLISH from Dokyl. Akad. Nauk SSSR (Moscow), v. 164, no. 3, 1965 p 545–548
(JPRS-33148; TT-65-33724) CFSTI: $1.00

The relationship of zonal and discrete (exciton) absorption in the X-ray spectra of atoms in polar crystals is under study. New experimental and theoretical results are considered, and

the X-ray spectra of the components that were obtained in crystals of LiCl, KCl, NaCl, RbCl, and AgCl are depicted. The position and width of the valence band in the cyrstals are indicated, and are in accord with experiments which agree with the values of the width of the valence zone in alkali halide crystals. The region of possible position of the lower limit of the conduction zone in alkali halide crystals, limited by comparison of various experimental data, is shown. It is concluded that in all of the X-ray absorption spectra of the components of the polar crystals, there is an extensive region (of the order of several electron volts) situated below the boundary of the conduction zone; this is related to the transition of the photoelectrons to the exciton energy levels.
R.W.H.

**N66-13944#** Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
**IMPERFECTIONS IN METALS. II: CORROSION AND OXIDATION Quarterly Report No. 8, 1 Jul.–31 Sep. 1964**
[1964] 32 p refs
(Contract EURATOM-082-62-7 RDB)
(EUR-2363; EURAEC-1404; R-2316) CFSTI: HC $2.00/MF $0.50

Thermal oxidation films formed on annealed titanium foils were recrystallized in order to study the defect structure of the rutile modification of titanium dioxide. By this procedure large monocrystalline areas were obtained suitable for transmission electron microscopy and diffraction. Several contrast effects were observed in these films. Extended fringe patterns, which sometimes formed closed loops, are attributed to antiphase boundaries. A model for the occurrence of this type of defect based on the idealized image of a hexagonal close-packed stacking of the oxygen ions in the rutile structure is proposed. This model is also reliable with the observation of twins with the (101) plane as boundary plane. The habit plane of the antiphase boundaries is in an irrational plane for the tetragonal rutile lattice; it is however a simple plane in the oxygen lattice. The antiphase boundaries moved easily under enhanced electron irradiation. Mutual annihilation and disappearance of the boundaries was observed by annealing in the microscope. The model further explains the observation of antiphase boundaries ending at dislocations and the behavior at the contract between these boundaries and twin boundaries. Finally, geometrically shaped contrast features were observed which are attributed to cavities.
Author

**N66-14030#** Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
**X-RAY DIFFRACTION STUDIES OF THERMAL MOTIONS IN CRYSTALS Quarterly Progress Report, 1 Mar.–31 May 1965**
R. A. Young 8 Jul. 1965 6 p
(Contracts Nonr-991(00); Nonr-991(06))
(QPR-24; AD-620437) CFSTI: HC $1.00/MF $0.50

Research on x-ray diffraction studies of thermal motions in crystals is summarized.
TAB

**N66-14189#** General Precision, Inc., Pleasantville, N. Y. GPL Div.
**RESEARCH AND DEVELOPMENT PROGRAM ON OPTICALLY PUMPED NUCLEAR GYROSCOPE First Quarterly Progress Report, 1 Jul.–30 Sep. 1965**
James H. Simpson 26 Oct. 1965 27 p refs
(Contract NOw-65-0577-d)
(GPL-A-33-1; AD-623328) CFSTI: HC $2.00/MF $0.50

The design and test of an electrodeless discharge mercury lamp was the chief subject of this portion of the nuclear gyroscope study program. A small, compact lamp and RF oscillator configuration has been found that has a satisfactory output. The mercury spectrum line at 2537 Å was examined in detail by means of a magnetic scanning technique. The intensity and lineshape of the lamp output were identical with that of the microwave energized electrodeless discharge lamp that was used in previous work with the experimental model of the nuclear gyroscope. The total power input to the new lamp is less than five watts, the input to the microwave lamp was in excess of 80 watts. Work was also begun on the design and construction of a phase stable amplifier using only solid state techniques.
Author (TAB)

**N66-14194#** Radio Corp. of America, Somerville, N. J.
**DEVELOPMENT OF INTEGRATED CIRCUITS UTILIZING COMPLEMENTARY TRANSISTORS Interim Development Report, 1 Jul.–30 Sep. 1965**
[1965] 37 p
(Contract NObsr-93365)
(IDR-1; AD-623510) CFSTI: HC $2.00/MF $0.50

Complementary pnp–npn bipolar integrated circuits can be fabricated by diffusing from a doped oxide source that is deposited on the silicon surface. This technique, wherein the doped oxide is deposted at a low temperature by the thermal oxidation of $SiH_4$, makes possible the simultaneous diffusion of oppositely doped impurites, so that 'mirror image' pnp–npn characteristics can be achieved. Substrate preparation, to maintain isolation between devices while providing proper collector regions for each, can be achieved by combining RCA's 'handle' oxide isolation technique with pocket etch and epitaxial refill techniques. Transistor masks were designed and fabricated, preliminary calibrations of the doped oxide systems were established for the required n and p concentrations, standard work stations for silane deposition systems were designed and ordered and single devices were fabricated using doped oxide diffusions.
Author (TAB)

**N66-14255*#** Radio Corp. of America, Princeton, N. J. RCA Labs.
**INTERACTION OF ELECTRONIC CURRENT WITH HYPERSONIC WAVES IN SOLIDS Quarterly Progress Report, 1 Jan.–31 Mar. 1964**
R. F. Mayo 10 Apr. 1964 27 p refs
(Contract NAS8-11120)
(NASA-CR-68098) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Emphasis is placed on current saturation effects and the build-up of acoustic flux in crystals of cadmium sulfide. A theoretical attempt was made to relate the radiation effects in CdS with phenomena seen in gallium arsenide and indium antimonide. A preliminary approach was made to a large signal analysis, and it is surmised that the current saturation in CdS is probably due to electric, rather than acoustic, saturation. The acoustic flux associated with the current saturation effect was observed experimentlly, and frequency components were tested which showed unexpectedly low frequency.
C.T.C.

# 27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

**N66-13810#** Library of Congress, Washington, D. C. Aerospace Information Div.
**COMPOSITION OF T-5 FUEL Review Article**
24 Mar. 1964 14 p refs
(AID-U-64-19; AD-622937) CFSTI: HC $1.00/MF $0.50

The report is to present the latest data on the composition and possible origin of the Soviet T-5 jet fuel and to evaluate these data. The fuel is defined as that of gas oil type, basically designed for supersonic aircraft. A reported source gives for the first time an exhaustive analysis of T-5 fuel, and a previously reported source is used for comparison. In the course of this comparison it was found that the physical and chemical properties of the actual analysis given in the former differ from the limit values of the specifications given in the latter. Moreover, there is also a difference between the actual composition of T-5 fuel as given in the former and in the analyses given in AD-621874. The probable reasons for differences are discussed and evaluated. TAB

**N66-14010#** Naval Radiological Defense Lab., San Francisco, Calif.
**THE RADIOLYTIC DECOMPOSITION OF 1,1-DIMETHYLHYDRAZINE, DIETHYLENETRIAMINE AND HYDYNE ROCKET FUELS**
Wesley E. Shelberg 19 Aug. 1965 15 p refs
(USNRDL-TR-896; AD-622334) CFSTI: HC $1.00/MF $0.50

One hundred-milliliter samples of the storable liquid rocket fuels, 1,1-dimethylhydrazine, diethylenetriamine, and Hydyne generate respectively 199.0, 101.2 and 164.1 ml of radiolytic off-gas (measured at 25C and 1 atm) when irradiated to 8,500,000 rads with gamma rays. The result for Hydyne was calculated from those for 1,1-dimethylhydrazine and diethylenetriamine, Hydyne consisting of 60 wt-% of the former and 40 wt-% of the latter. When the samples contain 5 vol-% of the free radical scavenger methyl methacrylate, the off-gas volumes are reduced respectively by 18.2, 11.0 and 16.7 %. Since the free-radical scavenger reduces somewhat the off-gas from the fuels due to laboratory ionizing radiation, it may be expected to improve their storability somewhat with respect to ionizing space and nuclear rocket radiations. Author (TAB)

**N66-14076#** Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
**GENERAL RESEARCH. SOLUBILITIES OF $N_2$, He, AND Ar IN LIQUID $N_2O_4$**
E. T. Chang and N. A. Gokcen 20 Oct. 1964 22 p refs
(ATN-64-(9228)-4)

The solubility of nitrogen, helium, and argon in liquid dinitrogen tetroxide has been measured over a wide pressure range at −11, 13, 0.0, and 25.0° C. The results show, conclusively, that Henry's law is obeyed for all pressures at each temperature. The standard free energy, enthalpy, and entropy of solution for each gas have been computed. Author

# 28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

**N66-13485*#** National Aeronautics and Space Administration, Washington, D. C.
**PLASMA ENGINES AND THEIR POTENTIALITIES [PLAZMENNYYE DVIGATELI I IKH VOZMOZHNOSTI]**
Yu. Berestov Dec. 1965 16 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), v. 48, no. 8, 1965 p 64–69
(NASA-TT-F-9798) CFSTI: HC $1.00/MF $0.50 CSCL 21C

General aspects and future possibilities of the plasma engine are reviewed briefly, with description of its use in the navigation system of the Mars probe Zond-2. A suggested classification of plasma engines, according to working medium, type of magnetic field, and type of heating is given. Diagrammatic views of crossed-field plasma accelerators, with cryogenic superconducting materials for the electromagnet windings and making use of Lorentz forces for accelerating the plasma are included. Preference is given to plasma engines with acceleration in their own magnetic field, using coaxial electrodes and/or front discharge. A 50% increase in efficiency is expected from magnetoplasma engines using Hall currents. Author

**N66-13678#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**LIMITING POWER OF CLOSED-CYCLE GAS TURBINES**
V. I. Batishchev 24 Sep. 1965 15 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 4, 1964 p 14–16
(FTD-TT-65-626/1+2+4; AD-622374) CFSTI: HC $1.00/MF $0.50

The effect of various factors on the magnitude of the limiting power of closed-cycle gas turbines is examined. Author (TAB)

**N66-13707#** Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.
**AUSTRALIAN INTERESTS IN THE FUTURE OF THE SMALL PRIME-MOVER**
D. R. Warren and M. Zockel Aug. 1964 42 p refs
(ARL/ME-262) CFSTI: HC $2.00/MF $0.50 CSCL 21G

The development status and research trends in mechanical prime movers up to 500 horsepower are reviewed. Seven combustion engine systems are considered: reciprocating spark ignition; reciprocating compression ignition; free piston; rotary piston; gas turbine; Stirling cycle vapor engine; and the indirect electrical prime mover. The prospects and limitations of each system are assessed, and the alternative of using electrical power as an indirect prime mover link between fossil fuels and useful mechanical power is also discussed. The particular aspects of energy use in Australia are outlined in relation to the economic requirements of the country. The recommendation was made that, in addition to the gas turbine, research could be directed to the rotary piston engine, weight reduction in the two-stroke diesel, and a wider application of the indirect electrical prime mover. M.G.J.

**N66-14012#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**NOZZLE OF A JET ENGINE**
K. V. Shulikov 22 Sep. 1965 5 p Transl. into ENGLISH from Russian patent no. 166244 (Appl. no. 10682/350455/40-23, 18 Dec. 1946) 2 p
(FTD-TT-65-782/1+2+4; AD-622375) CFSTI: HC $1.00/MF $0.50

The object of the invention is a jet engine nozzle, characterized by the fact that for the purpose of gaining the possibility of controlling the thrust vector in vertical plane, it is provided with a turning-in-vertical-plane fitting, mounted on thrust bearings and work gear coupled with drive meachanism. Author (TAB)

**N66-14156*#** Atlantic Research Corp., Alexandria, Va.
**DESIGN, TEST, AND DOCUMENTATION OF THE MARC 36A1, 1-KS-75 SPIN MOTOR FOR THE SCOUT VEHICLES**
Washington, NASA, Jan. 1966 45 p ref Prepared for Ling-Temco-Vought, Inc.
(Contract NAS1-3899)
(NASA-CR-359) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A general description of the motor design of the MARC 36A1, 1-KS-75 solid propellant spin control rocket motor used in Scout vehicles is presented. A photograph of the spin motor, and a cross sectional diagram of the motor are given. A table of thermodynamic and physical properties of the aluminized plastisol composite propellant, Arcite 427B, used in the spin motor is also given. Static-firing tests conducted on 35 heavy-wall motors and 27 flightweight MARC 36A1 motors in a vacuum chamber are discussed, and tabulated ballistic data summaries are presented for the heavywall motors, and flightweight motors in various developmental stages. Other tables given include comparisons of the motor skin temperatures with and without a thermal barrier, and case skin temperatures from development and preflight rating firings. A reliability and documentation review is also presented, and the delivery of ten flightweight motors was authorized. L.S.

**N66-14161*#** Electro-Optical Systems, Inc., Pasadena, Calif.
**ION ROCKET SYSTEM RESEARCH AND DEVELOPMENT Final Report, 24 Feb. 1964–25 Jun. 1965**
G. Sohl, G. C. Reid, F. A. Barcatta, S. Zafran, and R. C. Speiser 30 Dec. 1965 252 p refs
(Contract NAS3-5250)
(NASA-CR-54323; EOS-4920-Final) CFSTI: HC $6.00/MF $1.50 CSCL 21C

A program of applied research; component development and extended testing on a 10 mlb thrust engine is reported. High performance was achieved with both electromagnet and permanent magnet versions of the engine. An electromagnet engine was operated for a total thrusting time of 2610 hours at the nominal design point of 7000 seconds specific impulse, 10 mlb thrust and a power-to-thrust ratio of 182 kw/lb. A 100 mlb engine design and results of tests of a new neutralizer concept are reported. Author

**N66-14235*#** Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.
**AERODYNAMIC DESIGN AND ESTIMATED PERFORMANCE OF A TWO-STAGE CURTIS TURBINE FOR THE LIQUID OXYGEN TURBOPUMP OF THE M-1 ENGINE**
R. Beer 19 Nov. 1965 64 p refs
(Contract NAS3-2555)
(NASA-CR-54764; AGC-8800-12) CFSTI: HC $3.00/MF $0.75 CSCL 21H

A two-stage turbine was designed for use in the oxidizer turbopump of the M-1 Engine. At its design point, the turbine produces 26,800 horsepower at a velocity ratio of .133 and an estimated efficiency of .53. Blunt edged turbine rotor airfoils are used throughout. Beside superior performance at subsonic Mach numbers, these airfoils (in the form of hollow sheet metal blades) offer advantages in fabricability, thermal fatigue resistance, and weight savings as compared to airfoils with sharp leading and trailing edges. Author

## 29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

**N66-13351*#** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**CONTRIBUTIONS OF THE UNIVERSITY OF MINNESOTA TO THE NINTH INTERNATIONAL CONFERENCE ON COSMIC RAYS**
Oct. 1965 151 p refs Conf. held in London, Sep. 1965
(NASA-CR-68663; CR-82) CFSTI: HC $5.00/MF $1.00 CSCL 20H

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**N66-13352*** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**MODULATION OF COSMIC RAYS BY AN ELECTRIC FIELD**
P. S. Freier and C. J. Waddington *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 3–16 refs (See N66-13351 04-29)
CFSTI: HC $5.00/MF $1.00
(Contract Nonr-710(60))

A modulation model is discussed which assumes that the decreased intensity of the cosmic radiation is due to the energy loss experienced by particles passing through electric fields in the solar system. The model is mathematically equivalent to a heliocentric electric field. By assuming that the particle source spectra are power laws in total energy per nucleon, the modulation of the differential and integral intensities of protons and

helium nuclei are calculated. The predicted modulation observed by sea level neutron monitors and meson detectors is also calculated and is given as a function of cutoff rigidity. These calculations are compared to the measurements made during the last solar cycle. Author

**N66-13353*** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**LOW ENERGY MULTIPLY CHARGED NUCLEI IN THE COSMIC RADIATION**
P. S. Freier, J. S. Rno, and C. J. Waddington *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 17–24 refs (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Contract Nonr-710(60))

Nuclear emulsions mounted in plate "shufflers" were exposed at some 2.5 g/cm$^2$ over Fort Churchill in 1963 and 1964. These emulsions have been examined for the tracks of multiply charged, $Z \geq 3$, nuclei, with particular emphasis being paid to those particles brought to rest in the emulsions. From these ending particles it appears that during this period near solar minimum the ratio of L to M-nuclei with $170 \leq E \leq 360$ MeV per nucleon, corrected to the top of the atmosphere, is 0.55 ±0.18, which is appreciably greater than the value observed at higher energies. Also given are values for the total integral intensity of all $Z \geq 3$ nuclei in each year, and the differential intensity of M-nuclei derived from the ending particles. Author

**N66-13354*** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**VERY HEAVY LOW ENERGY COSMIC RAY NUCLEI**
C. J. Waddington and P. S. Freier *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 25–34 refs (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Contract Nonr-710(60))

A stack of nuclear emulsions having a surface area of 900 cm$^2$ and mounted in a pressure activated emulsion "camera" was exposed during 1964 at a residual pressure of 2.1 mbs over Fort Churchill. These emulsions are being used to measure the intensity of all nuclei having charges of 20 or greater and the differential energy spectrum of these $Z \geq 20$ nuclei between 240 MeV/n and 650 MeV/n. This range of energies covers the region where nuclei of different charges might be expected to show the greatest spectral changes due to propagation or other causes. Provisional results are reported on the energy spectrum and intensities of these nuclei. These results show that, if acceleration processes are neglected, the mean amount of interstellar or source material traversed by these nuclei does not exceed 2 g/cm$^2$. Author

**N66-13355*** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**ELECTRONS, HYDROGEN AND HELIUM NUCLEI OF THE COSMIC RADIATION AS OBSERVED IN 1963 AND 1964**
C. J. Waddington and P. S. Freier *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 35–47 refs (See N66-13351 04-29) CFSTJ: HC $5.00/MF $1.00
(Contract Nonr-710(60))

Nuclear emulsions were exposed over Fort Churchill in plate "Shufflers" flown in 1963 and 1964. Preliminary data on the low energy hydrogen and helium nuclei observed in 1963 have already been reported. These observations have now been extended to cover a wider range and to include electrons. A similar analysis has been made in the shuffler stack flown in 1964 at a time when the counting rate of high latitude sea level neutron monitors had increased by 2.8%. In both stacks the energy spectrum of the hydrogen nuclei has been studied over the energy range, 80 MeV $\leq E \leq$ BeV, which represents a considerable extension over previously available techniques. Similarly the helium nuclei have been studied over an energy range of 70 MeV/n $\leq E \leq$ 1.3 BeV/n, so that for the first time those two components have been studied over a widely overlapping range of rigidities, $0.74 \leq R \leq 4.0$ BV. Integral and differential intensities for both years are presented, as are those on the small number of electrons observed in each stack. Analysis of these results shows that in this energy range, the modulation cannot be solely velocity dependent and that there exists a clear discrepancy between these results and some of these reported for the IMP-I satellite. Author

**N66-13356*** Minnesota Univ. Minneapolis. School of Physics and Astronomy.
**STUDIES OF PRIMARY COSMIC RAYS WITH IONIZATION CHAMBERS**
S. R. Kane, J. R. Winckler, and R. L. Arnoldy (Honeywell Res. Center) *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 48–63 refs (See N66-13351 04-29) CFSTI: HC$5.00/MF $1.00
(Contract NAS5-2071)

It is shown that the response of ion chambers in the atmosphere and in free space is peaked over narrow rigidity intervals; these are 1.5–2.5 bv, 2.5–3.5 bv and 3.0–4.0 bv for free space, high latitude balloon and Minneapolis balloon chambers, respectively. Using these results and measurements made with the Pioneer V, Mariner II and OGO-A ion chambers, the rigidity dependence of the long-term modulation during 1960–1965 is found to be consistent with the form $p^{-\beta}$, where $\beta \simeq 0.8$. The solar cycle effect at 10 g/cm$^2$ as measured by balloon flights at Minneapolis and high latitudes is presented. A phase lag of about one year between the total ionization and sunspot numbers exists throughout the cycle. A correlation plot of the high latitude balloon ionization rate and the Deep River neutron monitor for 1958–1965 shows a smooth relationship between the two rigidity ranges. The rigidity dependence of the short-term modulation as measured with space ion chambers in several cases is shown to be different than the long-term. This "turn-up" in ionization in the atmosphere at high latitudes observed at solar minimum can be attributed to the presence of low energy S nuclei in the primary radiation at solar minimum. The peak ionization intensity of the present solar minimum appears to have occurred in May 1965. Author

**N66-11357*** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**MEASUREMENT OF THE ISOTOPIC COMPOSITION OF HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION IN THE ENERGY INTERVAL 80–150 MeV/NUCLEON**
D. J. Hofmann and J. R. Winckler *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 64–73 refs Sponsored by NSF (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00

A dE/dX – E scintillation counter device was flown at high altitude over Barrow, Alaska for a period of about 30 hours on 12 May 1965, a time of absolute solar minimum. The detector was capable of resolving protons, deuterons, $He^3$ and $He^4$ nuclei. In this paper, only the helium nuclei results will be discussed. Energy and rigidity spectra are extracted for $He^3$ and $He^4$ taken separately. The ratio $He^4/He^3+He^4$ is found to be constant over the energy interval 81–150 Mev/nucleon with a value of 0.19 ±0.05 and in terms of ridigity, the ratio is found to be 0.39 ±0.09 at .8 Bv. The relation of these ratios to the solar modulation is discussed. Author

N66-13358* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**MEASUREMENTS OF THE PRIMARY PROTON AND HELIUM SPECTRA AND THEIR MODULATIONS USING A BALLOON BORNE CERENKOV-SCINTILLATION COUNTER**
J. F. Ormes and W. R. Webber *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 74–87 refs (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Grant NsG-281-62)

During the years 1963–1965, the spectra of protons and helium nuclei have been studied on eleven flights at seven geomagnetic latitudes using a modified version of the Cerenkov-scintillation counter. The flights attained depths of 2–6 g/cm$^2$ which coupled with the detector's large geometry factor (~50 st cm$^2$) enabled details of the helium intensity, and the different contributions, primary and secondary, to the singly charged distribution to be evaluated as a function of atmospheric depth. These results demonstrate that it is necessary to know in detail the contribution of all non-primary components, particularly at the lower energies, before a spectrum of primary protons can be determined. The spectra of primary protons and helium nuclei measured on these flights are presented. These spectra cover the range from ~0.6–16 Bv rigidity. Our results indicate that the lowest energy protons have increased by more than 50% between 1963 and 1965. The proton spectrum is almost flat down to 0.5 Bv in 1965, but the helium spectrum is falling sharply at the corresponding rigidities. A study of the modulation of these two components during this period reveals that the modulation depends approximately on $1/\beta$ for $0.45 \leq \beta \leq 0.85$ for both components, and at the same velocity, the modulation for protons is $\geq 2 \times$ that for helium nuclei. Author

N66-13359* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**SOME IMPLICATIONS OF THE RELATIVE SPECTRA OF THE DIFFERENT CHARGE COMPONENTS IN THE PRIMARY RADIATION**
W. R. Webber *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 88–99 refs (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Grant NsG-281-62)

In accompanying papers we have presented the differential spectra of the individual charge components—protons through heavy nuclei—measured at different levels of solar modulation from 1963–1965. Utilizing the fact that the solar modulation affects particles of different charge to mass ratio in such a way that the ratio of intensities in differential rigidity intervals are not changed, we are able to compare the relative spectra prior to solar modulation. This comparison suggests the following: (1) The relative spectra of protons and helium nuclei are most reasonably interpreted in terms of identical rigidity spectra at the "source" rather than energy/nucleon spectra. The large increase in P/He (P) ratio at low rigidities may in large part be due to production of secondary protons as well as ionization loss in the interstellar medium. (2) The variation of the P/He, L/H and He/N ratios with energy can be interpreted in terms of ionization loss of the primary radiation moving through an amount of material which monotonically decreases with increasing energy. (3) The spectra of heavy nuclei above 3 Bv systematically become steeper with increasing charge. Author

N66-13360* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**MEASUREMENTS OF THE ENERGY SPECTRUM OF NUCLEI WITH $Z \geq 3$ IN THE PRIMARY RADIATION USING BALLOON BORNE CERENKOV-SCINTILLATION COUNTER**
W. R. Webber, J. F. Ormes, and T. von Rosenvinge *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 100–110 (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Grant NsG-281-62)

The spectra of the so called L, M and H nuclei have been measured on eleven balloon flights at seven geomagnetic latitudes during the period 1963–1965. The instrument used is a modified version of the Cerenkov-scintillation counter. These spectra have been measured over the range 1.5 to 16 Bv. The flights attained depths of 2–6 g/cm$^2$ which, coupled with the detectors large geometrical factor (~ 50 st cm$^2$) has enabled details of the absorption of the L, M and H components to be studied in the upper atmosphere. The large geometrical factor has allowed identification of over 10,000 nuclei with $Z \geq 3$, with over 2000 being observed on a single flight. A total of ~ 150 VH nuclei have been observed and the spectra of these nuclei has been found to be similar to that of M and LH nuclei above ~ 2 Bv. The spectra of the L nuclei is found to be significantly different from that of the M and H nuclei, with the exponent on a power law energy spectrum being 0.3 ±0.1 larger. The M and LH nuclei spectra are also different than the He nuclei spectra above 3 Bv; the exponent on a power law spectrum being 0.1 ±0.03 larger, with the integral spectrum being given by an average exponent of −1.6 ±0.03 over the range 3–16 Bv. The solar modulation of these nuclei is found to be similar to that of the He nuclei. Author

N66-13361* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**SOLAR MODULATION OF PROTONS AND HELIUM NUCLEI DURING THE PERIOD 1963–1965**
W. R. Webber *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 111–123 refs (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00
(Grant NsG-281-62)

The low rigidity portions of the primary spectra of protons and helium nuclei have been measured on six occasions during 1963–1965 using a Cerenkov-scintillation counter carried to altitudes of 2 to 6 g/cm$^2$ by balloons. The range of rigidities over which detailed spectral measurements have been made is 0.4 to 2 Bv for protons and 0.8 to 4 Bv for helium nuclei. The measurements cover a period of decreasing solar modulation as evidenced by an increase in Mt. Washington neutron monitor rate from a value ~2300 in the summer of 1963 to ~2450 in 1965. The increase in neutron monitor rate was accompanied by much larger increases in the low energy protons and helium nuclei, amounting to a factor of almost two at the lowest rigidities. The energy dependence of the modulation of both protons and helium nuclei is consistent with a $1/\beta$ dependence for $0.45 \leq \beta \leq 0.85$. However, at the same velocity, the modulation for protons is $\geq 2 \times$ that for helium nuclei. The modulation thus produces identical changes in the rigidity spectra of the two components. This model is inconsistent with a simple diffusion model for the 11-year variation such as suggested by Parker (1963). However, a model in which diffusion and energy loss occur simultaneously and are of approximately equal importance is explored and found to be capable of producing the observed modulation. Author

N66-13362* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**RAPPORTEUR PAPER ON "SPECTRA"**
C. J. Waddington *In its* Contrib. of the Univ. of Minn. Oct. 1965 p 124–149 ref (See N66-13351 04-29) CFSTI: HC $5.00/MF $1.00

This paper summarizes some of the more interesting and striking results reported at a cosmic radiation conference during

sessions on energy spectra of particles in the primary cosmic radiation. Discussions are included on X-ray and gamma ray astronomy, electrons in the primary cosmic radiation, protons and helium nuclei, isotropic composition, and heavy nuclei with atomic numbers greater than 3. R.N.A.

**N66-13605*#** State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

**ON THE USE OF ELECTRICAL ION SOURCES FOR ION TRACER EXPERIMENTS IN THE MAGNETOSPHERE**

Edward W. Howes, Jr. Aug. 1965 22 p refs *Its* Rept.-65-31 (Grant NaG-233-62)

(NASA-CR-68502) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The present paper examines the possibility of using an electric ion source in orbit around the earth to generate probes for magnetospheric studies of (a) electric fields, (b) ion diffusion, and (c) the distant magnetic field configuration. It is concluded that studies (a) and (b) can be done using an electric ion source whose construction is probably within the present state of the art. Study (c), however, requires an ion source whose development in a size and weight suitable for sending into orbit may be outside the state of the art. Author

**N66-13635*#** Lockheed Nuclear Products, Marietta, Ga.

**SHIELDING PROBLEMS IN MANNED SPACE VEHICLES**

W. M. Schofield, E. C. Smith, and C. W. Hill Dec. 1962 197 p refs

(Contract NAS8-879)

(NASA-CR-68578; ER-5997) CFSTI: HC $5.00/MF $1.25 CSCL 20H

The hazards of solar flares to manned space flights are reviewed. It is shown that space radiations incident on material shields produce secondary radiations which may rival or exceed the dose due to primary radiations. Methods of calculating radiation transport through shields are discussed, and the results of sample calculations are presented. An analysis of electron bremsstrahlung produced by electrons in the natural radiation belts shows that this component is small compared to the proton dose for escape missions. However, the electrons resulting from nuclear weapon bursts may possess energies of seven MeV or higher; thus, penetrating electrons may be important for thinly shielded vehicles. It is concluded, therefore, that it would be desirable to develop transport methods for electrons in this energy range. R.R.D.

**N66-13638*#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.

**PRODUCTION SPECTRUM OF HIGH ENERGY ELECTRONS FROM HIGH ENERGY COSMIC RAY COLLISIONS**

Martin S. Spergel and Joseph H. Scanlon Jun. 1965 32 p refs Sponsored by NASA

(NASA-CR-68566; RE-213J) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The distribution of charged pions from proton-proton collisions is combined with the cosmic ray flux and the distribution of electrons from $\pi$-$\mu$-e decay to give the production spectrum of electrons from cosmic ray collisions. The proton-proton collisions are described by the Landau hydrodynamical model. Calculations are performed for electron energies between 20 and $10^8$ GeV. The electron production spectrum is seen to exhibit approximately an $E_e^{-3.3}$ behavior, where $E_e$ is the electron energy. Author

**N66-13657#** California Univ., Livermore. Lawrence Radiation Lab.

**SOURCES OF ARTIFICIAL RADIATION BELTS**

N. Christofilos 10 Aug. 1965 9 p Presented at Conf. on Radiation Trapped in the Earth's Magnetic Field, Bergen

(Contract W-7405-ENG-48)

(UCRL-14374; Conf-650816-1) CFSTI: HC $1.00/MF $0.50

Since nuclear explosions in outer space have been banned, the discussion concerns other possible sources of artificial radiation belts. The placing of electron accelerators and radioactive isotopes in orbit is considered. It is concluded that the best possible method is the positron emitters. NSA

**N66-13786** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**PRELIMINARY RESULTS OF MEASUREMENTS OF DISTRIBUTED COSMIC RADIO EMISSION INTENSITY AT FREQUENCIES OF 725 AND 1525 kc ON THE ELEKTRON 2 SATELLITE**

Ye. A. Benediktov, G. G. Getmantsev, Yu. A. Sazonov, and A. F. Tarasov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 190–196 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Recordings from the Elektron II satellite give distributed cosmic radio emission measurements of $0.51 \cdot 10^{-20}$ and $0.87 \cdot 10^{-20}$ watt $\cdot$ m$^{-2}$ $\cdot$ cycle$^{-1}$ $\cdot$ steradian$^{-1}$ at 725 and 1525 kc, respectively. At satellite-to-earth distances up to 68 000 km, observed radio emission may be difficult to explain in terms of noise of terrestrial origin permeating the ionosphere. It is shown that effective sky temperature increases and radio emission intensity decreases as frequency is lowered in the 1–2 Mc range. Drop in intensity can be explained in terms of absorption of cosmic radio emission in the interstellar ionized gas; and, in part by the frequency-spectrum peculiarities of the extragalactic cosmic emission sources. M.W.R.

**N66-14060*#** National Aeronautics and Space Administration, Washington, D. C.

**INVESTIGATION OF PRIMARY COSMIC RAYS ON THE "PROTON-1" SPACECRAFT**

N. L. Grigorov, V. Ye. Nesterov, I. D. Rapoport, I. A. Savenko, and G. A. Skuridin Dec. 1965 57 p refs Transl. into ENGLISH from the Russian paper "Issledovaniye Pervichnykh Kosmicheskikh Luchey na Nauchnoy Stantsii 'Proton-I'" Presented at 16th Intern. Astronautical Congr., Athens, Sep. 1965

(NASA-TT-F-9794) CFSTI: HC $3.00/MF $0.50 CSCL 20H

The article is divided into chapters, each discussing a certain facet of studies on the "Proton-1" space laboratory. Chapter I examines the craft itself; Chapter II examines apparatus for studying high- and superhigh-energy particles and the electron-photon components of primary cosmic rays. Chapter III discusses preliminary results of cosmic ray study conducted on "Proton-1." Author

**N66-14135*#** Israel Program for Scientific Translations, Ltd., Jerusalem.

**SOLAR-ACTIVITY FORECASTING**

Yu. I. Vitinskii 1965 135 p refs Transl. into ENGLISH of the Book "Prognozy Solnechnoi Aktivnosti" Leningrad, Izd. Akad. Nauk SSSR, 1962

(NASA-TT-F-289; TT-65-50115) CFSTI: HC $4.00/MF $1.00 CSCL 04A

This book on solar activity forecasting discusses the following: (1) the basic regularities of solar cycles; (2) solar activity forecasts a year or several years in advance; (3) medium-period forecasts of solar activity; (4) ultralong-range forecasts of solar activity; and (5) forecasts of the basic characteristics

of the twentieth cycle. In considering solar activity indexes, it is recognized that at present there is nothing better than empirical-statistical methods of Wolf-number prediction. The forecasting of sunspot areas is mostly confined to qualitative estimates. E.E.B

**N66-14202#** Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
**RADIATIVE COOLING OF STELLAR MATERIAL WITH APPLICATIONS TO SOLAR FLARES**
Ludwig Oster Sep. 1965 52 p refs
(D1-82-0420; AD-623297) CFSTI: HC $3.00/MF $0.50

Characteristic times for the cooling of stellar material by spontaneous emission for temperatures between $10^7$ and 10,000K, and for gas pressures corresponding to log $P_g = -2$ to $+4$, or alternately, electron densities between $10^8$ and $10^{14}$/cc are derived. These data are used to predict the time development of an element undergoing a cooling process. The numerical calculations are carried out for equilibrium conditions and continuous emission in an optically thin layer. However, the influences of departures from equilibrium, of line emission, and of finite optical thickness are estimated. The results are applied to a theoretical analysis of relevant flare observations. It is, in particular, shown that on the basis of the above arguments along a position of the initial flare event in photospheric layers cannot be excluded. Author (TAB)

**N66-14275*#** Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
**ABUNDANCES AND ENERGY SPECTRA FOR NUCLEI OF GALACTIC ORIGIN ABOVE 20 MEV PER NUCLEON**
G. M. Comstock, C. Y. Fan, and J. A. Simpson [1965] 16 p refs
Presented at Intern. Conf. on Cosmic Rays, London, 6-17 Sep. 1965 Submitted for Publication
(Contract NAS5-2133; Grants NsG-179-61; AF-AFOSR-521-65)
(NASA-CR-68999; EFINS-65-88) CSCL 20H

The individual chemical abundances of nuclei with charge Z extending from Z = 2 to Z = 14 in the energy range 20 to 300 Mev/nucleon have been measured in interplanetary space on the OGO-I satellite for ~ 150 hours in October and November 1964. At higher Z, two charge groups were measured, including the Fe-group. The energy spectra for C, O and Ne are shown to be remarkably flat and different from the helium spectrum measured simultaneously over the same energy/nucleon range. It is concluded that these spectral differences exist in the cosmic radiation outside the solar system. The relative abundances for $6 \leq Z \leq 14$ display an even-odd Z ratio of approximately 8:1. Li, Be and B, and the Fe-group are present with about the same relative abundances as observed at higher energies. It is suggested that the rate of particle acceleration for a wide range of Z competes effectively with the rate of ionization loss at these low energies. The measurements were made with solid-state silicon detectors and anti-coincidence scintillators arranged to measure energy-loss and total energy. Author

**N66-14312#** Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
**A STUDY OF VERTICALLY INCIDENT COSMIC-RAY TRAJECTORIES USING SIXTH-DEGREE SIMULATIONS OF THE GEOMAGNETIC FIELD**
M. A. Shea, D. F. Smart, and K. G. Mc Cracken Sep. 1965 382 p refs *Its* Environ. Res. Papers No. 141
(AFCRL-65-705; AD-623632) CFSTI: HC $7.00/MF $1.75

A study has been made of vertically incident cosmic-ray trajectories at more than 400 positions on the earth's surface using sixth-degree simulations of the quiescent geomagnetic field. Twenty-six of these positions are near the South African magnetic anomaly, and six other points are in a region of the North Atlantic where Pomerantz and Agarwal have reported anomalous results. The trajectories have been calculated for rigidities separated by intervals as small as 0.01 bv to allow for the effects of the penumbra. When these trajectories are used to determine cosmic-ray cutoff rigidities, differences greater than 15 percent from the Quenby and Wenk threshold values are found in the vicinity of South Africa, the South Atlantic, and the Canary Islands. Various latitude surveys are shown to exhibit consistency when plotted against the cutoff rigidities determined by this computational method. It is concluded that although currently available simulations of the geomagnetic field are not completely adequate over some portions of the earth to describe the cosmic-ray effects in their entirety, there is essentially no difference in the cutoff rigidities determined using two currently accepted field models, even though different penumbral structures are obtained. Asymptotic directions of approach and cutoff rigidities for a number of locations are listed.
Author (TAB)

# 30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

**N66-13364*#** Arizona Univ., Tucson.
**COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 3, NUMBER 50**
D. W. G. Arthur et al 1965 163 p refs
(Grant NsG-161)
(NASA-CR-68590) CFSTI: HC $5.00/MF $1.00 CSCL 03B

The designation, diameter, position, central peak information, and state of completeness are listed for each discernible crater with a diameter exceeding 3.5 km in the third lunar quadrant. The catalog contains about 5200 items and is illustrated by a map in 11 sections. Author

**N66-13382*#** Bendix Corp., Southfield, Mich. Research Labs. Div.
**MASS SPECTROMETER FOR LUNAR ANALYSIS STUDY Final Summary Report, 1 Jun.-31 Aug. 1963**
G. J. O'Halloran, L. D. Fergusion, F. W. Poblenz, and L. Walker 30 Nov. 1963 165 p refs
(Contract NAS8-5370)
(NASA-CR-68824; RLD-2542) CFSTI: HC $5.00/MF $1.00 CSCL 03A

A mass spectrometer was investigated to analyze the lunar atmosphere. Discussed are the desirability of a lunar compositional analysis; the operational and environmental constraints at launch, voyage, approach, and landing; compositional analyses techniques; and time-of-flight mass spectrometry for fulfilling the lunar analysis instrumentation requirement. Also, the general characteristics and motions of the moon; temperature measurements of the moon; calculation of the lifetimes of various lunar gases; and the physical properties of gas components are included. E.E.B.

**N66-13398*#** IIT Research Inst., Chicago, Ill. Astro Sciences Center.
**PERTURBATION, SIGHTING AND TRAJECTORY ANALYSIS FOR PERIODIC COMETS: 1965–1975**
F. Narin and P. M. Pierce 6 Oct. 1964 118 p refs
(Contract NASr-65(06))
(NASA-CR-59867; T-7) CFSTI: HC $4.00/MF $0.75 CSCL 03A

Possible intercept missions to the well known short period comets in the years 1965–1975 have been analyzed, to delineate those of potential interest in long range planning. A total of 36 well known comets having 55 perihelia in the period 1965 to 1975 were considered, plus Halley's comet with its perihelion in 1986. Detailed perturbation calculations were performed to determine the positions and perihelion dates of the 37 comets moving under the influence of gravitational fields of the Sun and planets. Ballistic trajectories to the comets were then calculated to determine ideal velocity, time of flight, closing velocity and communications distance as a function of launch date. Sighting calculations were performed to determine the expected brightness of the comets and the number of hours the comet might be visible in the night sky. Author

**N66-13501*#** Maryland Univ., College Park. Dept. of Physics and Astronomy.
**[LONG WAVELENGTH INVESTIGATIONS OF SOLAR, PLANETARY, AND GALAXY EMISSIONS] Final Report, May 1–Sep. 30, 1964**
William C. Erickson and Max M. Komesaroff [1964] 12 p refs
(Grant NsG-615)
(NASA-CR-68711) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The feasibility of constructing several instruments for radio astronomy studies and spectral observations is discussed. Requirements for the development of a large high resolution antenna array, extending over several miles aperture, for ground based observations of discrete sources, the sun, and the Galaxy are outlined. Methods of obtaining extremely high resolution for the study of the structure of high brightness temperature sources either through lunar occultations, long baseline interferometers, or space vehicles are summarized. The feasibility of a swept frequency receiving system above the ionosphere for solar observations below 10mc/sec is investigated. M.R.W.

**N66-13513#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**CONTROL PROGRAMS FOR LET-DOWN FROM CIRCULAR ORBIT**
V. M. Ponomarev [1965] 14 p Transl. into ENGLISH from "Control Theory for Space Vehicle Motion" Moscow, Nauka Press, 1965 p 350–369

The feasibility of using the lateral aerodynamic force to curve or control the trajectory of a space vehicle during let-down is investigated. The case is limited to when the let-down orbit and the initial circular orbit are coplanar. Various constraints are taken into account in selecting the control program: domain of admissible values of velocity and altitude during let-down into the atmosphere; total quantity of delivered heat; and time of overload action. The ballistic let-down program, a control program in which all the aerodynamic coefficients remain constant, is analyzed. A presented example shows that by selecting the angle of entry into the dense atmosphere, it is possible that the same constraints may be satisfied in a constant positive quality descent as in a ballistic descent. A descent with constant negative quality is characterized by less time, less range, and a lesser quantity of heat as compared with the ballistic descent. However, the maximum overload and the maximum heat flux are greater than in the ballistic descent. M.R.W.

**N66-13546*#** National Aeronautics and Space Administration, Washington, D. C.
**ORBITAL MECHANICS OF RENDEZVOUS MISSIONS**
15 Oct. 1965 91 p
Available from the Scientific and Technical Information Division CSCL 22C

Fundamental concepts and conditions of orbital rendezvous missions are discussed. A technical presentation of the basic phenomena of orbital mechanics is given and related to the Gemini 6 mission. The two major problems in rendezvous maneuvers are plane and phase, and the critical time to solve these problems is at the instant of launch. Diagrams of various inclined spacecraft trajectories and target orbits are included. G.G.

**N66-13556*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SPACE PROGRAMS SUMMARY NO. 37-35, VOLUME IV FOR THE PERIOD AUGUST 1, 1965 TO SEPTEMBER 30, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT**
31 Oct. 1965 374 p refs
(Contract NAS7-100)
(NASA-CR-68793; JPL-SPS-37-35, Vol. IV) CFSTI: HC $7.00/MF $2.00 CSCL 22C

Supporting research and advanced development are reported for the Systems, Guidance and Control, Engineering Mechanics, Engineering Facilities, Propulsion, Space Sciences, and Telecommunications Divisions and the Quality Assurance and Reliability Office. Subjects summarized include the following: *Systems Analysis; Scientific Programming; Spacecraft Power; Spacecraft Control; Guidance and Control Research; Flight Computers and Sequences; Materials; Applied Mechanics; Lunar Spacecraft Development; Aerodynamic Facilities; Polymer Research; Solid and Liquid Propulsion; Lunar and Planetary Sciences; Chemistry; Fluid Mechanics; Physics; Communications;* and *Parts Reliability.* E.E.B.

**N66-13573*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**THE ROTATION OF THE PLANET MERCURY**
Giuseppe Colombo and Irwin I. Shapiro 15 Nov. 1965 27 p refs Revised
(Grant NSG-87-60)
(NASA-CR-68703; SAO Special Rept.-188-R) CFSTI: HC $2.00/MF $0.50 CSCL 03C

Reliable radar observations and some of the generally unreliable optical observations of Mercury are shown to be consistent with its rotating in a direct fashion with a period just two-thirds of its orbital period. This possibility may be understood as a consequence of the combined solar torques exerted on tidal deformations and on a permanent asymmetry in Mercury's equatorial plane, as suggested by Colombo. A simple model illustrating this superharmonic resonance phenomenon is developed in some detail; several alternative paths by which Mercury could have reached its present state of motion are discussed briefly. Author

**N66-13574*#** Aeronutronic, Newport Beach, Calif.
**STUDY OF A HIGH RESOLUTION FACSIMILE SYSTEM EXPERIMENT ON THE SURFACE OF THE PLANET MARS Final Report**

25 Feb. 1965 427 p refs Prepared for JPL
(Contract JPL-950996)
(NASA-CR-68626; U-3034) CFSTI: HC $7.27/MF $2.25
CSCL 22A

A study program was performed to determine the feasibility of conducting a high resolution facsimile camera experiment on the surface of the planet Mars. The mission considered would begin just prior to a 300 to 500 feet per second impact on the Martian surface and would last until the facsimile picture data were transmitted to earth. The total weight was restricted to the range of 300 to 600 pounds. The salient capsule subsystems which were parametrically studied are hard landing technology, high resolution facsimile system, telecommunications, transmitter and antenna configuration, memory systems, thermal control, and sterilization. Beneficial results were arrived at in several areas with a significant advance having been made in hard impact technology. A mathematical model was derived for the unidirectional balsa wood impact limiter which took into account both the dynamic and static impact characteristics of the limiter. The study concluded with the conceptual design of a 450-pound capsule capable of surviving a 400 feet per second impact and subsequently scanning and transmitting back to Earth a 24 X 24 degree picture. It was concluded that such a capsule is feasible for a 1969 to 1971 Mars mission.
Author

**N66-13614#** Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.
**THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC EMISSION AT 408 Mc/s Progress Report, Jan.–Mar. 1965**
Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1965] 7 p
(Contract N62558-3928)
(PR-2; AD-621828) CFSTI: HC $1.00/MF $0.50

Methods for restoring the strip brightness of 3C 245 are outlined, and preliminary restorations at four different position angles, using a 5 second of arc resolution, indicate that the source has an angular size of the order of 8 seconds of arc. A position finding computer program is also reported, in which the right ascension and declinations of catalogued stars and radio objects are converted into standard plate coordinates. The output is fed into an X-Y plotter, and a plot is produced which can be photographed down to scale on a transparency. The transparency is positioned so that the dots lie over the catalogued stars; the point of sky in the direction of the radio source lies under the corresponding dot. Astronomical observations were also made of a peculiar galaxy (VV 144), an optical object resembling an old supernova remnant, and of the North Polar Spur.
M.G.J.

**N66-13680#** Library of Congress, Washington, D. C. Aerospace Information Div.
**METEORITES Compilation of Abstracts**
D. Michaels and N. Cantacuzene, comp. 16 Apr. 1964 10 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 23, 1963 p 3–135 *Its* Rept.-5
(AID-U-64-23; TT-65-64295; AD-622941) CFSTI: HC $1.00/MF $0.50

The Tunguak, Lazarev, Yurtuk, Okhansk, Sikhote-Alinsk, and other iron, and stony-iron meteorites are considered in a series of abstracts of articles from the Soviet literature. Genetic laws in the chemical composition of chondrites, a comparison of bitumens of carbon chondrites and rocks, and the composition of tektites are also discussed. The progress of meteor astronomy from 1958 through 1961 is mentioned.
M.W.R.

**N66-13681#** RAND Corp., Santa Monica, Calif.
**COMMENTS ON THE DETECTION OF WATER AND ICE CLOUDS ON VENUS**
D. Deirmendjian Oct. 1965 14 p refs Presented at the JPL/CIT Conf. on the Moon and Planets, Pasadena, Calif., 13–18 Sep. 1965
(P-3245; AD-622987) CFSTI: HC $1.00/MF $0.50

Recent infrared spectroscopic evidence of the existence of ice clouds on Venus is verified by comparison with the spectra of optically dense, terrestrial sunlit cirrus clouds. The uncertainties regarding the total water content of the planetary atmosphere are pointed out, and an experiment is proposed for the detection of possible water droplet clouds, otherwise obscured by the observed ice clouds.
Author (TAB)

**N66-13686#** RAND Corp., Santa Monica, Calif.
**A MORPHOLOGICAL CLASSIFICATION OF E AND SO GALAXIES IN TERMS OF EQUILIBRIUM ISOPLETHS**
Dominic G. B. Edelen Feb. 1965 33 p refs
(P-3065; AD-622768) CFSTI: HC $2.00/MF $0.50

A representative collection of isoplethic surfaces is obtained from a kinematically self-consistent morphological classification of E and SO galaxies. The underlying geometry is that of oblate spheroids, and the function is obtained as a longitude-independent solution of the linearized discretization equation. Morphological classification parameters are discussed and characteristic profiles are presented, and the discretization equation is evolved for determination of galactic profiles.
M.W.R.

**N66-13756#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**PROBLEMS OF CELESTIAL MECHANICS**
23 Jul. 1964 78 p refs
(ATD-U-64-78; AD-622243) CFSTI: HC $4.00/MF $1.00

This report reviews Soviet open-source literature on the problems of celestial mechanics. Topics include: Introduction to problems of motion of celestial bodies; the n-body problem and perturbations of motion; analytical expansion of the perturbation function into series; differential equations for perturbations and their solutions; and variations of elements and solutions of the differential equations. A bibliography is also included.
TAB

**N66-13776#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**COSMIC RESEARCH, VOLUME 3, No. 4, 1965**
18 Oct. 1965 283 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. III, no. 4, 1965 p 507–663
(FTD-TT-65-1262/1+2; AD-622386) CFSTI: HC $6.00/MF $1.50

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2. A STUDY OF SPACECRAFT MOTION IN THE ATMOSPHERE N. I. Zolotukhina, D. Ye. Okhotsimskiy p 36–55 refs (See N66-13778 04-30)

3. A GENERALIZED VERSION OF THE NEWTON METHOD FOR THE SOLUTION OF BOUNDARY PROBLEMS V. A. Vinokurov and Yu. N. Ivanov p 56–64 refs (See N66-13779 04-23)

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9. CERTAIN POSSIBILITIES AND RESULTS OF IONOSPHERIC MEASUREMENTS FROM SLANT OBSERVATION OF THE FARADAY EFFECT IN GEOPHYSICAL-ROCKET SIGNALS V. A. Misyura, D. D. Osipov, Ye. B. Krokhmal'nikov, G. K. Solodovnikov p 172–189 refs (See N66-13785 04-13)

10. PRELIMINARY RESULTS OF MEASUREMENTS OF DISTRIBUTED COSMIC RADIO EMISSION INTENSITY AT FREQUENCIES OF 725 AND 1525 kc ON THE ELEKTRON 2 SATELLITE Ye. A. Benediktov, G. G. Getmantsev, Yu. A. Sazonov, and A. F. Tarasov p 190–196 refs (See N66-13786 04-29)

11. RESULTS OF A RADIO COMMUNICATIONS EXPERIMENT BETWEEN THE JODRELL BANK AND ZIMENKI OBSERVATORIES VIA ECHO 2 AND THE MOON AT 162.4 Mc G. G. Getmantsev, N. I. Kalashnikov, V. L. Bykov, Ye. A. Benediktov, L. M. Yerukhimov et al p 197–214 refs (See N66-13787 04-30)

12. EXPERIMENT IN OBSERVATION OF ARTIFICIAL EARTH SATELLITES USING A TELEVISION SYSTEM Ye. S. Agapov, V. F. Anisimov, V. M. Mozhzherin, V. B. Nikonov, V. V. Prokof'yeva et al p 215–222 refs (See N66-13788 04-30)

13. CERTAIN PROBLEMS OF PHYSIOLOGICAL MEASUREMENT IN INTERPLANETARY FLIGHTS R. M. Bayevskiy p 223–236 refs (See N66-13789 04-04)

14. OCCURRENCE OF DOMINANT LETHALS IN DROSOPHILA UNDER THE INFLUENCE OF VIBRATION, ACCELERATION AND $\gamma$-IRRADIATION G. P. Parfenov p 237–254 refs (See N66-13790 04-04)

15. INFLUENCE OF VIBRATION ON BONE-MARROW CELL DIVISION G. L. Pokrovskaya, L. A. Belyayeva, and A. V. Golovkina p 255–265 refs (See N66-13791 04-04)

16. COMPARISON OF COLLISION EFFECTS PRODUCED BY METEORITES AGAINST SURFACES OF VARIOUS METALS L. B. Livanov p 226–269 refs (See N66-13792 04-30)

17. INVESTIGATION OF A ROCKET-CARRIED ELECTROSTATIC FLUXMETER Ya. M. Shvarts, N. T. Markchev, A. N. Petunin, V. P. Rudakov, and V. V. Skvortsov p 270–275 refs (See N66-13793 04-14)

**N66-13777** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ANALYSIS OF INTERPLANETARY TRAJECTORIES FOR FLIGHTS INVOLVING CONSTANT-POWER PROPULSION SYSTEMS**

V. V. Beletskiy, V. A. Yegorov, and V. G. Yershov *In its* Cosmic Res., Vol. 3, No. 4, 1965 8 Oct. 1965 p 1–35 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

An analytical method of approximate computation of spatial trajectories for interplanetary flight with a constant-power propulsion system (a low-thrust propulsion system) is employed for a mass calculation of trajectory characteristics for flights to Mars, Venus, and Jupiter with (and without) return to earth. The accuracy of the method in the determination of the power consumption is of the order of 10% in first approximation, and of the order of 1% in second approximation. Considered are families of trajectories for a flight with a power-optimum thrust acceleration vector and a constant-magnitude acceleration changing direction through a single discontinuity. A graphic method is proposed for the representation of the results to permit determination of the optimum trajectories for a given purpose from among the entire grouping of trajectories. Author

**N66-13778** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**A STUDY OF SPACECRAFT MOTION IN THE ATMOSPHERE**

N. I. Zolotukhina and D. Ye. Okhotsimskiy *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 36–55 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

The entry of a space vehicle into the atmosphere is considered, upon its return to earth, at the second cosmic velocity (orbital velocity). The possibility of using controlled lift is analyzed from the standpoint of reducing maximum acceleration and expanding the re-entry corridor for a given level of maximum acceleration. We examine versions with a constant lift-to-drag ratio during the course of the descent and with a variable lift-to-drag ratio over an acceptable range. Author

**N66-13780** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ON THE PROBLEM OF ROTATING THE PLANE OF A SATELLITE ORBIT**

Yu. M. Kopnin *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 65–84 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

The paper considers the problem of rotating the orbital plane of a satellite by means of a force acting along the normal to the osculating orbital plane. The geometric shape of the osculating orbit remains unchanged under the influence of forces of this kind. By introduction of new dependent variables, the problem is reduced to investigation of a system of three first-order linear differential equations in which only a single variable coefficient figures. Cases in which the resulting equations are integrable are investigated; here the change in the inclination angle of the orbital plane from its initial position is described by a finite formula. Using the maximum principle of L.S. Pontryagin, we investigate the problem of rotating the plane of a circular satellite through a specified angle $i_\Sigma$ at which the shape of the osculating orbit remains unchanged and the characteristic velocity expended in the process is minimal. Use of exact solutions enables us to solve this problem in analytic form for both unfixed and fixed times of orbital-plane rotation. Author

**N66-13782** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ACCURACY IN DETERMINATION OF THE VERTICAL WHEN SIGHTING THE HORIZON IN THE INFRARED REGION OF THE SPECTRUM**

V. N. Branets *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 109–136 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Investigated are the errors which arise in the determination of the vertical by the method of sighting the horizon in the infrared region of the spectrum. Found is the magnitude of the regular error and the correlation function of the random component of the error for the instrument receiving the integral radiation. Author

**N66-13787** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**RESULTS OF A RADIO COMMUNICATIONS EXPERIMENT BETWEEN THE JODRELL BANK AND ZIMENKI OBSERVATORIES VIA ECHO 2 AND THE MOON AT 162.4 Mc**

G. G. Getmantsev, N. I. Kalashnikov, V. L. Bykov, Ye. A. Benediktov, L. M. Yerukhimov et al *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 197–214 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

A one-way radio communications link at 162.4 Mc between the Jodrell Bank and Zimenki observatories made use of Echo II and the moon. Reflected signal level from the Echo satellite was subjected to considerable fluctuation in time. Slow fluctuations, with characteristic times of one to two minutes, are associated with deviations of the satellite surface as well as tracking errors. Rapid fluctuations, of three to 10 seconds, may be due to the presence of inhomogeneities on the satellite surface. Teletype and voice-recording performance were impaired by rapid and deep fluctuations. Average signal level from Echo II fell three to five decibels short of calculated value. Unforeseen losses up to three decibels may be due to difference in polarizations of transmitted and received signals. M.W.R.

**N66-13788** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**EXPERIMENT IN OBSERVATION OF ARTIFICIAL EARTH SATELLITES USING A TELEVISION SYSTEM**

Ye. S. Agapov, V. F. Anisimov, V. M. Mozhzherin, V. B. Nikonov, V. V. Prokof'yeva et al *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 215–222 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

Visual and photographic observations down to magnitudes eight and nine can be made of earth satellites by use of a highly sensitive television with a very small feeder optical system. The use of visual observations permits the location of satellites from rough ephemerides and tracking over large arcs of visible trajectory. Practically all of the objects could be followed from the moment of their detection until they approached the horizon, indicating the practicability of relatively small and inexpensive optical systems for such observations. M.W.R.

**N66-13792** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**COMPARISON OF COLLISION EFFECTS PRODUCED BY METEORITES AGAINST SURFACES OF VARIOUS METALS**

L. B. Livanov *In its* Cosmic Res., Vol. 3, No. 4, 1965 18 Oct. 1965 p 266–269 refs (See N66-13776 04-30) CFSTI: HC $6.00/MF $1.50

The relationship between the depth of a crater resulting from a meteorite explosion and the parameters of the meteorite is used to compare meteorite collision effects on various metal surfaces. A summary of physicomechanical properties for aluminum, beryllium, iron, lithium, magnesium, and titanium indicates advantages for the lighter metals. M.W.R.

**N66-13820#** Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

**A SURVEY OF RADIO OBSERVATIONS OF SOLAR ECLIPSES**

John P. Castelli and Jules Aarons Aug. 1965 79 p refs *Its* Spec. Rept.-30

(AFCRL-65-533; AD-622564) CFSTI: HC $3.00/MF $0.75

A survey of reported radio observations of solar eclipes is presented. The eclipse has revealed the radio spectra of the solar centers of activity, the contribution of the corona to meter wavelength solar flux, the radio diameter of the sun at various wavelengths, and the height of the emitting regions. Eclipse studies have shown the portions of the radio spectrum where limb brightening is observed as well as those characterized by limb darkening. Through a detailed study of the results of major eclipses which have been observed, many aspects of solar radio measurements are considered. Appendices include a bibliography, as well as abstracts, on radio measurements of eclipses, together with details of data reduction techniques used in eclipse observations. Author (TAB)

**N66-13840*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.

**ATMOSPHERIC DENSITIES AND TEMPERATURES FROM THE DRAG ANALYSIS OF THE SAN MARCO SATELLITE**

Luigi G. Jacchia and Franco Verniani 12 Nov. 1965 13 p refs (Grant NsG-87-60)

(NASA-CR-68782; SAO Special Rept.-193) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Atmospheric densities have been obtained from the drag analysis of the San Marco Satellite in the interval from December 19, 1964, to February 11, 1965. Temperatures have been computed from the densities using Jacchia's 1964 atmospheric model. The analysis is based on field-reduced Baker–Nunn observations and on Minitrack observations. Author

**N66-13842*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**SYSTEMS ENGINEERING IN SPACE EXPLORATION**

1 Jun. 1965 55 p Proc. of the Space Technol. Seminar, Stanford Univ., Calif., 1 May–5 Jun. 1963

(Contract NAS7-100)

(NASA-CR-68801) CFSTI: HC $3.00/MF $0.50 CSCL 22A

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4. SPACE FLIGHT OPERATIONS M. Johnson p 39–43 (See N66-13846 04-30)
5. PROGRAM ENGINEERING AND PROJECT PROBLEMS J. Small p 45–53 (See N66-13847 04-30)

**N66-13843*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**SYSTEMS ENGINEERING IN SPACE EXPLORATION**

John Small *In its* Systems Eng. in Space Exploration 1 Jun. 1965 p 1–14 (See N66-13842 04-30) CFSTI: HC $3.00/MF $0.50

An introduction to systems engineering as applied to planetary mission design is presented. The various elements of the system are described and related problems discussed. Specific projects are cited, and a set of mission objectives which could be used for a Mars mission are given. General discussion of flow diagrams, event schedules, and support areas are included. C.T.C.

**N66-13844*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**SYSTEMS DESIGN**

Walter J. Downhower *In its* Systems Eng. In Space Exploration 1 Jun. 1965 p 15–31 (See N66-13842 04-30) CFSTI: HC $3.00/MF $0.50

A general discussion is given of systems design and systems design studies. These terms are explained by means of definitions and examples, and it is shown how these activities are used in such major programs as Ranger and Surveyor. A study of several Apollo support aspects of the unmanned lunar program, and a study of how to make a measure of lunar surface hardness utilizing the particular capability of the Ranger spacecraft are included as specific examples. C.T.C.

**N66-13845*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**SYSTEMS ANALYSIS**

C. R. Gates *In its* Systems Eng. in Space Exploration 1 Jun. 1965 p 33–37 (See N66-13842 04-30) CFSTI: HC $3.00/MF $0.50

A discussion is presented which explains and describes the technology of systems analysis, and shows how systems analysis contributes to the design and flight of lunar and planetary spacecraft. The discussion is made in two parts by giving a general definition, and an explanation utilizing a specific example. This example deals with the design of a trajectory for a lunar mission, in which such areas as range safety, preinjection tracking, and high payload weight are considered. C.T.C.

**N66-13846*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**SPACE FLIGHT OPERATIONS**

Marshall S. Johnson *In its* Systems Eng. in Space Exploration 1 Jun. 1965 p 39–43 (See N66-13842 04-30) CFSTI: HC $3.00/MF $0.50

A description is given of what space flight operations encompass, what they entail, the degree of effort devoted to them, and how and where they are conducted. General discussions are given for the deep space instrumentation facility, the space flight operations complex, launch site, communications facilities, and space flight checkout facilities. The functions which these facilities perform, and their relation to space flight operations are considered. C.T.C.

**N66-13847*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**PROGRAM ENGINEERING AND PROJECT PROBLEMS**

John Small *In its* Systems Eng. in Space Exploration 1 Jun. 1965 p 45–53 (See N66-13842 04-30) CFSTI: HC $3.00/MF $0.50

Consideration is given to the relationship that exists between mission objectives, resources (money, manpower, facilities), and boundary conditions (schedule, performance, reliability). Emphasis is placed on overall mission objectives relative to determining why a project might fail. Included are discussions of critical support areas, cost and time development factors, development possibility curves, and mission schedules. The Mariner program is cited as a specific example. C.T.C.

**N66-13967#** Princeton Univ., N. J. Dept. of Astrophysical Sciences.

**RESEARCH INTO THE DESIGN FEATURES OF A HIGH-RESOLUTION ULTRAVIOLET SPECTROSCOPIC SATELLITE Report No. 24 (Final)**

Lyman Spitzer, Jr., Kurt A. Dressler, and John B. Rogerson, Jr. Apr. 1965 27 p refs

(Contract AF 19(604)-4972)

(AFCRL-65-393; AD-623587) CFSTI: HC $2.00/MF $0.50

A chronological account is given of the early investigations of a telescopic satellite. This includes a design study control contract for an ultraviolet spectrometer, the fabrication of a 32-inch satellite mirror, and steps taken to develop ground-based data handling equipment. During the term of the contract the design study of a high resolution, ultraviolet spectroscopic satellite resulted in the recommendation of a Cassegrain telescope containing a one-meter concave-grating spectrometer. The design of the spectrometer was based on the availability of (1) a uniform and efficient grating, and (2) efficient photomultiplier tubes with highly uniform cathode areas. The purpose of the laboratory-test program at the Princeton University Observatory (PUO) was the selection and testing of gratings and photomultipliers to establish the availability of components with the desired properties. Author (TAB)

**N66-13992*#** IIT Research Inst., Chicago, Ill. Astro Sciences Center.

**LOW-THRUST TRAJECTORY AND PAYLOAD ANALYSIS FOR SOLAR SYSTEM EXPLORATION UTILIZING THE ACCESSIBLE REGIONS METHOD**

A. L. Friedlander Jul. 1965 52 p refs

(Contract NASr-65(06))

(NASA-CR-68888; T-14) CFSTI: HC $3.00/MF $0.50 CSCL 22C

A simple and graphic means, called the accessible regions method, of delineating generalized trajectory energy requirements for solar system exploration is described. The method also provides a convenient graphic assessment of payload capabilities by relating the requirements to specific vehicle systems. The utilization of the accessible regions method to low-thrust fly-by missions throughout the solar system is discussed. By analogy to the $\Delta V$ associated with ballistic flight, the time integral of thrust acceleration squared, J, is used to link trajectory energy requirements and vehicle system characteristics for low-thrust flight. Several diagrams showing thrust and variable thrust J contours and payload contours for flight times of various periods to the various planets in the solar system are depicted. L.S.

**N66-14001*#** Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

**REPORT OF AUGUST 1965 TYCHO MEETING**

[1965] 448 p refs Meeting held in Boulder, Colo., Aug. 1965

(Contract NSR-24-005-047)

(NASA-CR-68896; TG-1) CFSTI: HC $7.48/MF $2.25 CSCL 22A

The results of the TYCHO Study Group conference on the lunar surface are reported and include its conclusions and recommendations, aspects and comments on present knowledge of the lunar surface, a summary of lunar surface research contributions, and the background of the TYCHO Study Group. The appendices contain the research contributions which include papers on lunar internal temperatures, lunar surface erosion by meteor impact, lunar radar studies, lunar volcanism, photography on the moon's surface, dust levitation on the lunar surface, the potential and electric field at the lunar surface, interpreting brightness and polarization curves of the moon, electromagnetic and thermal properties of the moon's surface, evidence for a particulate matter in space and its potential accretion rate by the moon and Earth, mechanisms for lunar luminescence, structure of the lunar dust layer, and some considerations concerning radar returns from the lunar limb. R.N.A.

**N66-14011#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ON THE ORIENTATION OF ARTIFICIAL EARTH SATELLITES**
E. F. Fatkhullin 8 Oct. 1965 20 p refs Transl. into ENGLISH from Tr. Univ. Druzhby Narodov (Moscow), v. 1, no. 1, 1963 p 71–86
(FTD-TT-64-756/1+2; AD-622360) CFSTI: HC $1.00/MF $0.50

The present paper is devoted to the study of the stability of a given satellite-orientation in free space. The control elements are three reaction-wheels. The investigation is based on Lyapunov's second method. The equations of distributed motion are derived, the Lyapunov function is constructed, the sufficient conditions of stability of the undisturbed motion are found, and the region of initial perturbations is determined. . . . TAB

**N66-14014#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**DISTRIBUTION OF LOOK ANGLES TO A NEAR SYNCHRONOUS SATELLITE**
Maxine H. Simon 8 Sep. 1965 7 p
(Contract AF 19(628)-5167)
(TN-1965-47; ESD-TDR-65-425; AD-621746) CFSTI: HC $1.00/MF $0.50

There is interest in determining the distribution of look angles to a near synchronous equatorial satellite for ground stations at various latitudes. A computer program was written to determine these distributions with ground station latitude and minimum acceptable look angle as parameters.
Author (TAB)

**N66-14032#** RAND Corp., Santa Monica, Calif.
**CONSTANTS THAT AREN'T CONSTANT, AND THEIR EFFECTS ON SIMPLE ORBIT CALCULATIONS**
G. M. Northrop Sep. 1965 13 p refs
(P-3225; AD-620926) CFSTI: HC $1.00/MF $0.50

The discussion is intended to illustrate some of the difficulties the ordinary researcher is apt to encounter as a result of imprecise knowledge of astronomical and laboratory units of measurement. Variations in gravitational constants of the earth and of the diameter of the earth are given. The author concludes: Beware of constants; chances are they aren't. TAB

**N66-14057*#** National Aeronautics and Space Administration, Washington, D. C.
**VOLCANIC ACTIVITY ON MARS [VULKANICHESKAYA AKTIVNOST' NA MARSE]**
G. N. Katterfel'd Jan. 1966 18 p refs Transl. into ENGLISH from Priroda (Moscow), no. 8, 1965 p 103–109
(NASA-TT-F-410) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The Mars opposition occurred in March, 1965—the most favorable time for observing its surface from the earth. Many astronomers pursued a great many studies at this time, which provided new information about Mars. Therefore, the present article has become timely. The author of this article has utilized many data published during the last 55 years, primarily data obtained by Japanese astronomers which are almost unknown to the Soviet reader. Author

**N66-14082** Tokyo Astronomical Observatory (Japan).
**DISCUSSIONS OF OCCULTATIONS OBSERVED IN JAPAN WITH THE PHOTOELECTRIC EQUIPMENTS FROM 1960 TO 1962**
Shinko Aoki, Minoru Takahashi, and Yoshiko Endo Repr. from Tokyo Astron. Bull., Ser. 2, no. 167, 5 Jan. 1965 p 2053–2059 refs
CFSTI: HC $1.00/MF $0.50

The preliminary corrections used in carrying out the reductions of the photoelectric observations of occultation are listed, and the findings tabulated. Data are given on the working number; the name and number of each occulted star; the phenomena of disappearance and reappearance; the observed time of occultation; the observing station number; apparent places of the occulted star; hour angle of the star at each observing time; position angles of the star, and of the motion of the moon; coefficients for solving the least square equations; symbols for topocentric libration; and height of limb. Results obtained by the least squares method are listed, and the plumb deviation effect is compared. Details are also included on the positions of the observing stations. M.G.J.

**N66-14150#** RAND Corp., Santa Monica, Calif.
**EQUILIBRIUM THEORY OF GALACTIC ISOPLETHS: A RELATIVISTIC ANALYSIS**
Dominic G. B. Edelen Sep. 1965 83 p refs
(P-3221; AD-622415)

A complete summary is given of analyses of problems involved in the relativistic description of galactic structures from the standpoint of hypersurfaces of geometric equilibrium that carry jump discontinuities in the momentum-energy tensor. A reasonable theory is developed for the observed morphology of E and SO galaxies. Several tentative predictions are made concerning the diameters of E galaxies. TAB

**N66-14155*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**OPTIMIZATION OF DOUBLE-CONIC INTERPLANETARY TRAJECTORIES**
Edward A. Willis, Jr. Washington, NASA, Jan. 1966 41 p refs
(NASA-TN-D-3184) CFSTI: HC $2.00/MF $0.50 CSCL 22C

An efficient class of high-thrust double-conic interplanetary trajectories in which each one-way planet-to-planet transfer may consist of two distinct coasting arcs joined by an optimal midcourse impulse, are compared with conventional single-conic trajectories using one-way and stopover round trips to Mars as typical examples with total velocity increment, trip time, and stay time for criteria. The analysis is based on a successive two-body trajectory model. Low circular parking orbits at each planet, impulsive thrust, and coplanar elliptical planet orbits are assumed. The location, direction, and magnitude of the midcourse impulse are optimized directly by a convenient numerical search procedure. It was shown that double-conic trajectories significantly reduce the total velocity increment for one-way transfers covering heliocentric travel angles greater than 4 radians. Round-trip durations of 300 to 1000 days with stay times of 0 to 140 and 450 days in the years 1971 and 1980 were also studied. Curves, diagrams, and tables are given in support of the analysis. L.S.

**N66-14158*#** National Academy of Sciences—National Research Council, Washington, D. C. Prevention of Deterioration Center.
**THE METEOROID ENVIRONMENT AND ITS EFFECTS ON MATERIALS AND EQUIPMENT**
William A. Cosby and Robert G. Lyle 1965 119 p refs Prepared for NASA
(NASA-SP-78) GPO: HC $0.50; CFSTI: MF $0.75 CSCL 22A

A summary is presented of current understanding of the meteoroid environment and its effects on materials and equipment. The summary is based entirely on a literature survey of publications primarily appearing since late 1960 and is sectioned: The Environment, Hypervelocity Impact Phenomena, and Design Considerations. The environment section considers in detail the properties and distribution of interplanetary debris determined from: terrestrial observations of meteors; direct measurement by spacecraft and space probes; zodical light studies; and analysis of terrestrially accreted dust. The section on hypervelocity impact phenomena summarized recent theoretical and experimental studies which have contributed to the level of understanding now existent concerning the mechanisms of penetration, cratering, spalling, and perforation which may attend the impingement of meteoroids on surfaces and structures in space. The design considerations section considers weight reduction techniques, particularly the shield or bumper concept and self-sealing structures, and probability for perforation. Author

**N66-14192#** United Aircraft Corp., East Hartford, Conn. Research Labs.

**AN ASYMPTOTIC SOLUTION FOR OPTIMUM POWER-LIMITED ORBIT TRANSFER Final Report, 1963–1965**

T. N. Edelbaum Oct. 1965 12 p refs

(Contract AF 49(638)-1239)

(D-910090-4; AFOSR-65-2002; AD-623170) CFSTI: HC $1.00/MF $0.50

A complete first-order asymptotic solution was obtained for optimum power-limited transfer between coplanar elliptic orbits of arbitrary size, eccentricity, and orientation. The solution was obtained by the averaging method of Bogoliubov and Mitropolsky and corresponds to what they call 'the improved first approximation' including both secular and short-period terms. The problem for which the solution is presented corresponds to minimum-fuel transfer in fixed time of a low-thrust rocket operating at constant power and variable thrust. The average acceleration of the rocket is assumed small in relation to the acceleration of gravity. Analytic expressions were derived for the orbit elements, the payoff, and the optimum control. Author (TAB)

**N66-14199#** Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

**AURORAL ZONE RADIO STAR SCINTILLATION MEASUREMENTS AND INTERPRETATIONS**

John M. Lansinger Oct. 1965 45 p refs Presented at the 10th Symp. of the AGARD Ionospheric Res. Comm., Rome, 21–25 Sep. 1965

(Contract Nonr-3010(01))

(D1-82-0476; AD-623673) CFSTI: HC $2.00/MF $0.50

A quantitative evaluation and comparison are made of angular and amplitude scintillation data received at the College, Alaska, experimental station on 68 Mc/s with a lobe-sweep interferometer. The data are reduced with an automatic data processing system. A description is presented of a phase-compensation system which allows readily interpretable measurements to be made which represent the difference between the predicted and apparent position of the radio source. A lead/lag correlation analysis is made between ionospheric absorption, magnetic variation, and the angular and amplitude scintillation data. Some results are presented which show an association between short-term absorption events and the enhancement of scintillation activity. Power spectral analysis and cross-correlation analysis are made of the experimental data. Given several ionization models, the computed ground diffraction patterns are compared with experimental data. A comparison is made between the predicted variation of scintillation depth versus zenith angle, based upon a theoretical model for field-aligned irregularities and some earlier experimental results. Author (TAB)

**N66-14219#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CLASSIFICATION OF ORBITAL ORIENTATION SYSTEMS OF ARTIFICIAL EARTH SATELLITES**

Ye. N. Tokar and V. N. Branets [1965] 15 p refs Transl. into ENGLISH from a Russian Periodical, 1965 p 1–13

(FTD-MT-65-180; AD-622383) CFSTI: HC $1.00/MF $0.50

The problem of a spacecraft orientation in general reduces to matching analogous axes of a certain coordinate trihedron, which is connected with the vehicle Oxyz and the assigned trihedron $Ox_0y_0z_0$. By distinguishing the types of orientation, depending on the properties of absolute motion of trihedron $Ox_0y_0z_0$, it is possible to point out a class of orientation problems that is very important for practice, when trihedron $Ox_0y_0z_0$ accomplishes motion in absolute space with a constantly oriented vector of angular velocity which is other than zero. This report considers certain questions concerning the sensing devices (transducers) of orientation which can be used in solving problems of this type. R.N.A.

**N66-14243#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**ALMOST CIRCULAR ORBITS OF ARTIFICIAL EARTH SATELLITES**

M. A. Vashkov'iak [1964] 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), no. 3, 1964 p 58–67

A theory on the motion of an artificial satellite in a normal earth's attraction field is developed for calculating satellite motion with very low eccentricities. Analytic expansions for the satellite coordinates are obtained to the accuracy of the fourth degree in the quasi-eccentricity inclusively. All terms of first and second order in the earth's oblateness are retained in these expansions which are convergent for all time intervals. The problem is formulated, and numerical results are presented to show that the found formulas are convenient for practical calculations. M.G.J.

**N66-14266#** Royal Aircraft Establishment, Farnborough (England).

**FLUCTUATIONS IN THE DENSITY OF THE ATMOSPHERE IN 1960–1963, OBTAINED FROM THE ORBITAL VARIATIONS OF ARTIFICIAL EARTH SATELLITES [KOLEBANIYA ATMOSFERNOI PLOTNOSTI V 1960–1963 POLUCHENNYE PO IZMENENIYAM ORBIT ISKUSSTVENNYKH SPUTNIKOV ZEMLI]**

N. P. Slovokhotova Sep. 1965 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow, v. 3, no. 3, 1965 p 469–472

(RAE-LIB-TRANS-1128) CFSTI: HC $1.00/MF $0.50

The diurnal fluctuations in atmospheric density at heights of 200–300 km were investigated by analysing the observations of Soviet artificial earth satellites in 1960–1963. The investigations have confirmed the presence of diurnal fluctuations in density at these heights at a period near the minimum of solar activity (1962–1963). As a result of the diurnal effect the density at a height of 300 km varies approximately by a factor of 2, and at a height of 200 km by 10–20%. At a height

of approximately 300 km a small fall in density (of the order of 20%) has been noted (both by day and by night) between 1960 and 1962. Author

**N66-14269#** Joint Publications Research Service, Washington, D. C.
**THE FIRST COSMONAUTS ON THE MOON**
Konstantin Alekseyevich Kulikov 15 Dec. 1965 169 p refs Transl. into ENGLISH of the book "Pervyye Kosmonavty na Lune" Moscow, "Nauka" Publishing House, 1965 p 5–187
(JPRS-33337; TT-65-33912) CFSTI: $5.00

A high school level discussion is given of the moon and phenomena associated with it. Generalareas covered are auxiliary problems, what is reliably known about the moon, and phenomena observable from the moon. Such topics as solar and lunar eclipses, phases of the moon, landing on the moon, and observable motion of the planets are included. C.T.C.

**N66-14280#** RAND Corp., Santa Monica, Calif.
**SOME ASPECTS OF THE CIRCULATION OF MARS**
Conway Leovy Nov. 1965 27 p refs Presented at the Conf. on Exploration of the Planets, Blacksburg, Va., 16–20 Aug. 1965
(Contract NASr-21(07))
(NASA-CR-68992) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Estimates of the vertical temperature structure and heat balance of Mars are reviewed and compared with the corresponding quantities on the Earth. The probable resulting circulation is discussed, and reasons for expecting a stronger solstice circulation on Mars than on the Earth are given. The problem of thermally driven tides is reviewed. The amplitude of such tides is likely to be small. Author

**N66-14281*#** Geophysics Corp. of America, Bedford, Mass. Technology Div.
**PHYSICS OF PLANETARY ATMOSPHERES III: THE TIME-DEPENDENT COUPLED HARTREE-FOCK APPROXIMATION**
G. A. Victor and A. Dalgarno Aug. 1965 12 p refs
(Contract NASw-1283)
(NASA-CR-68991; GCA-TR-65-24-N) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A coupled Hartree–Fock approximation for describing the effects of time-dependent perturbations on many-electron systems is presented. It is applied to the calculation of the frequency-dependent refractive index of helium gas with results that differ by between 4% and 8% from the accurate values obtained by a refined variational calculation. Author

**N66-14298*#** Consultants and Designers, Inc., Arlington, Va.
**MAJOR VICTORY FOR SOVIET SCIENCE. NEW DATA ON THE INVISIBLE SIDE OF THE MOON**
Yu. N. Lipskiy 21 Aug. 1965 9 p ref Transl. into ENGLISH from Pravda (Moscow), no. 228, 17 Aug. 1965
(Contract NAS5-3760)
(NASA-CR-68974; ST-PR-LPS-10372) CFSTI: HC $1.00/MF $0.50 CSCL 03A

Soviet achievements ince the inception of the Lunik moon program are discussed, with special emphasis placed on the photographing of the far side of the moon by the Zond-3. Details are given on television equipment and transmission of the exposures, with photographing beginning at a distance of 11.6 thousand kilometers from the moon's surface and ending upon passing the minimum distance, somewhere below below 10000 kilometers. The trajectory, the position of the sun, and the distance between the probe and the moon's surface are discussed in relation to the photos obtained. Details of the lunar surface are described, and comparison with previously obtained data tends to confirm the conclusion that the density of crater disposition on the far side of the moon is higher. M.G.J.

**N66-14305#** RAND Corp., Santa Monica, Calif.
**PERTURBATIONS OF A GRAVITY GRADIENT STABILIZATION SYSTEM**
R. H. Frick Sep. 1965 68 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4679-ARPA; AD-623279) CFSTI: HC $3.00/MF $0.75

Satellite attitude stabilization systems utilizing the gradient of the earth's gravitational field have the advantage of being completely passive (i.e., no power is required). However, the stabilizing moments developed are extremely small and as a result such systems are subject to attitude perturbations from sources which would ordinarily be neglected in the evaluation of an active stabilization system. This memorandum investigates certain of these sources of attitude perturbation including micro-meteoroid impact, solar radiation pressure, station-keeping propulsion, orbital eccentricity, and on-board rotating machinery. In the analysis, formulas are developed which determine the magnitude of the pitch, roll and yaw perturbations resulting from each of the above sources. Application of these results to an assumed vehicle configuration shows that the resulting attitude perturbations can be of the order of several degrees. While these perturbations do not necessarily rule out gravity gradient stabilization, their magnitudes for a given gradient stabilization, their magnitudes for a given vehicle configuration should be considered for their compatibility with the mission requirements. Author (TAB)

**N66-14308#** Manchester Univ. (England). Dept. of Astronomy.
**RESEARCH INTO METHODS OF DETERMINING THE RELATIVE HEIGHTS OF PHYSIOGRAPHIC FEATURES OF THE MOON Appendix To Final Report**
G. A. Mills 29 Jan. 1965 52 p refs
(Contract AF 61(052)-524)
(AFCRL-65-431A; AD-623684) CFSTI: HC $3.00/MF $0.50

The method used for determining the apparent positions of objects on lunar photographs is outlined in detail. A possible scheme is suggested for combining these apparent positions to obtain absolute positions and heights of the features. A list of approximate coordinates of 960 points selected is given, together with a list of plate material available at the present time. Author (TAB)

**N66-14322#** Manchester Univ. (England). Dept. of Astronomy.
**RESEARCH INTO METHODS OF DETERMINING THE RELATIVE HEIGHTS OF PHYSIOGRAPHIC FEATURES OF THE MOON Final Report**
G. A. Mills 29 Jan. 1965 17 p ref
(Contract AF-61(052)-524)
(AFCRL-65-431; AD-623669) CFSTI: HC $1.00/MF $0.50

The relative merits of two alternative methods for determining the shape of the Moon are considered. It is concluded that the terminator method is inferior to the libration method because of the law of reflection of light from the surface of the Moon is not well known and cannot be ignored. Author (TAB)

# 31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

**N66-13403*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**VOYAGER DESIGN STUDY. VOLUME IV: SYSTEM DESIGN**
15 Oct. 1963 566 p refs
(Contract NASw-696)
(NASA-CR-51839; DOC.-63SD801) CFSTI: HC $8.66/MF $2.75 CSCL 22B

The following studies are reported: *Entry Lander*—design criteria and limitations, subsystem descriptions, basic trajectories, configuration matrix, etc.; and *Orbiter System Introduction*—configuration selection and sequence of events, configuration design and integration, thermal control, structural and dynamic criteria, and weight analysis. Considered were various systems requirements for entry into the Venus or Mars atmospheres. G.G.

**N66-13407*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**VOYAGER DESIGN STUDY. PART II, VOLUME III: SUBSYSTEM DESIGN**
15 Oct. 1963 407 p refs
(Contract NASw-696)
(NASA-CR-51837; Doc.-63SD801) CFSTI: HC $7.07/ MF $2.00 CSCL 22B

The following studies are reported: *Guidance and Control*—guidance analysis, attitude control, Voyager lander high gain antenna control, and alternatives; *Propulsion*—orbiter propulsion, lander propulsion, and attitude control propulsion; *Power Supply*—system selection and basic studies, recommended and alternate systems, power supply performance, and mission analysis. Evaluated were the Mars 1969 and 1971 orbiter, the Mars 1973 and 1975 back-up orbiter, the Mars 1975 bus, the Mars 1969 lander, Mars landers after 1969, and Venus landers. G.G.

**N66-13440#** Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
**GEMINI AGENA TARGET VEHICLE Reports Bibliography, Period Ending 30 Jun. 1964**
1 Sep. 1964 16 p refs
(Contract AF 04(695)-129)
(LMSC-A605144; SSD-62-80; AD-462886)

Contents: Communications and Control System Reports; Engineering/Technical Reports; Facilities Reports; Flight Planning Reports; Human Factors Reports; Service, Maintenance, and Operation Manuals; Presentations and Briefing Aids; Product Assurance Reports; Progress Reports; Propulsion System Reports; Study Reports; and Test Reports. TAB

**N66-13451*#** Bendix Corp., Ann Arbor, Mich. Systems Div.
**SURVEYOR LUNAR ROVING VEHICLE, PHASE I. VOLUME V: SYSTEM EVALUATION Final Technical Report**
Apr. 1964 124 p Prepared for JPL
(Contract JPL-950656)
(NASA-CR-68648; BSR-903, Vol. V) CFSTI: HC $4.00/MF $1.00 CSCL 22A

The Surveyor Lunar Roving Vehicle (SLRV) mission was evaluated to determine the required SLRV system probability of success for the site verification mission by comparison with the relative capability of other systems to accomplish the same objectives. The site verification mission was defined in terms of the data to be collected on the bearing strength of the lunar soil, small scale topography, and slope in the potential site area. The competitive programs analyzed included the Apollo LEM, Lunar Orbiting Satellite, Surveyor A, Apollo B, and second generation LRVs. In addition, an evaluation of the performance of SLRV systems for gross weights in excess of 100 lb is given, as well as the results of tests conducted during the study program on an engineering test model designed and fabricated to demonstrate mobility and maneuverability capabilities and limitations of the 100 lb design. R.N.A.

**N66-13475*#** Bendix Corp., Ann Arbor, Mich. Systems Div.
**SURVEYOR LUNAR ROVING VEHICLE, PHASE I. VOLUME III: PRELIMINARY DESIGN AND SYSTEM DESCRIPTION. BOOK 1: SYSTEM DESCRIPTION AND PERFORMANCE CHARACTERISTICS Final Technical Report**
Apr. 1964 144 p Prepared for JPL
(Contract JPL-950656)
(NASA-CR-68625; BSR-903, Vol. III, Bk. 1) CFSTI: HC $5.00/ MF $1.00 CSCL 22A

A preliminary design and system description is presented for the proposed Surveyor Lunar Roving Vehicle configuration. Included are a summary of mission and system requirements and descriptions of the system integration, mobility, structures, deployment, folding and erection mechanisms, penetrometer, navigation, control and display, telecommunications, primary power supply, television, thermal control, DSIF/SFOF (Deep Space Instrumentation Facility/Space Flight Operations Facility), operation sequence, and ground support equipment. In addition the vehicle's performance characteristics and limitations are summarized. R.N.A.

**N66-13557*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MARINER IV SCIENCE PLATFORM STRUCTURE AND ACTUATOR DESIGN, DEVELOPMENT AND FLIGHT PERFORMANCE**
G. Coyle 15 Nov. 1965 23 p
(Contract NAS7-100)
(NASA-CR-68571; JPL-TR-32-832) CFSTI: HC $1.00/MF $0.50 CSCL 22B

This Report describes the Mariner IV scan platform and actuator and the developmental problems encountered. Equipment test results and flight experience are summarized to support the discussion of design adequacy. The scan structure and actuator design are considered to be a reasonable solution within the framework of schedule, structural efficiency, interface definition, and—most important—desired function objectives. The design techniques and problem areas described are considered to be useful data for application to future spacecraft programs. Author

**N66-13569*#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**SATELLITE 1963 38C Semiannual Report, Period Ending Sep. 30, 1965**
Oct. 1965 35 p ref
(NASA ORDER R-21)
(NASA-CR-68649; SIP-66-65) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The satellite and its associated complement of charged particle detectors are described. The satellite has been operating over two years, and during this period there have been several occasions when, for one reason or another, some of the data have been unreliable. Some of these occasions are examined and when possible the cause of the reliability is explained. The satellite contains an integral electron spectrometer, a differential proton spectrometer, and a set of omnidirectional detectors. All of these instruments utilize solid state detectors and are described in detail. The satellite telemetry system is overdesigned from the viewpoint of transmitter power and as a result the data are usually clean and little has to be discarded. Various payload and instrument problems which have arisen are enumerated. E.E.B.

**N66-13618#** Joint Publication Research Service, Washington, D. C.
**THE FIRST THREE SOVIET SPACE ROCKETS**
8 Dec. 1965 1v8 p Transl. into ENGLISH of the book "Besprimernyy Nauchnyy Podvig" Moscow, State Publishing House of Physicomathematical Lit., 1959 p 5–202
(JPRS-33234; TT-65-33809) CFSTI: $5.00

A compilation of articles, originally published in Pravda, is presented. These reports deal with the first three Soviet rockets launched on a lunar trajectory. Technical details, flight progress, and mission results are covered. Also included are laudatory comments on the achievements, and congratulatory messages to the Soviet scientists, cosmonauts, and technical personnel who worked on the projects. M.G.J.

**N66-13768*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**OBSERVATION OF THE GT-5 ROCKET-BODY REENTRY: PRELIMINARY ANALYSIS**
Leonard H. Solomon 22 Oct. 1965 34 p refs
(Grants NsG-87-60; NsG-563)
(NASA-CR-68699; SAO-191) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Basic information derived from the Smithsonian Astrophysical Observatory (SAO) data and from available NORAD radar observations is presented. The data considered to have possible value for later analyses are: the time of breakup, the object's height, the trajectory of the main mass, the relation of the object to the earth's shadow, and the intersection of the trajectory with the ground. Also, the associated cloud is included. It is concluded that the SAO tracking stations acquired, tracked, and provided useful descriptive information of the GT-5 second-stage reentry. The height of the object and the velocity of separation of the fragments suggest that the breakup was not strictly analogous to meteor fragmentation. It is considered that the observations must be explained on the basis of interaction between the vehicle subsystems and the environment. Contributing factors may have been atmospheric friction, residual fuel, spin rate, or possibly pyrotechnics left on board. E.E.B.

**N66-13959*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SATELLITE SITUATION REPORT, VOLUME 5, NO. 19**
15 Oct. 1965 21 p
(NASA-TM-X-56999; X-537-65-217) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Objects in orbit data are reported as of 1200Z on October 15, 1965. Code name, catalogue number, source, launch date, period, inclination, apogee, perigee, and transmitting frequency are given. E.E.B.

**N66-14067*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**NIKE TOMAHAWK NOSE OPTIMIZATION STUDIES**
Edward E. Mayo, George A. Weisskopf, and Carl I. Hutton, Jr. Nov. 1965 83 p
(NASA-TM-X-55348; X-721-65-473) CFSTI: HC $3.00/MF $0.75 CSCL 22D

A study is underway to compare sounding rocket nose shapes with reference to their effects on altitude performance, overall vehicle stability, and bending moments about the payload-rocket interface. Other phases studied were comparative performance of tangent ogive and conical noses, and cone cylinder geometric and mass characteristics. R.W.H.

**N66-14088#** Centre National d'Etudes Spatiales, Paris (France). Division Information et Documentation.
**THE FR-1 SATELLITE [LE SATELLITE FR-1]**
Nov. 1965 60 p In FRENCH CFSTI: HC $3.00/MF $0.50

The mission of the FR-1 Satellite, to determine the characteristics of the ionosphere, is discussed; and a general description of the satellite, including its structure, its equipment and component systems, its dimensions and specifications, is given. Ionospheric properties are determined from a study of the mode of propagation of very low frequency electromagnetic waves through the ionosphere. These waves are broadcast to the satellite which amplifies and re-broadcasts them to the earth; the differences between the transmitted and received waves are then examined. Drawings, diagrams, and schematics are included. Transl. by D.T.

**N66-14120*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ANALYSIS OF SPACECRAFT FAILURES DURING THERMAL-VACUUM TESTING**
Kenneth L. Rosette *In its* Goddard Summer Workshop Program [1964] 6 p refs (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The results are reported of a study of the laboratory tests of three space programs: Ariel-1 (S-51), Ariel-2 (S-52), and the Interplanetary Monitoring Platform (IMP). The test philosophy employed has been to use environmental testing to gain information from which the suitability of a spacecraft for flight can be assessed. For the S-51 and S-52 programs, a prototype and two flight spacecraft were available. In each of these programs the units were tested in succession. The S-74 program contributed a prototype and a flight system. In each case, the prototype was launched into orbit and the flight system was tested about 6 months later. A breakdown of the number of failures encountered in the various subsystems is tabulated. For the purpose of statistical analysis, eight spacecraft are not sufficient. It is recommended that this type of study be continued and made a part of every spacecraft evaluation program. E.E.B.

**N66-14173#** National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
**SOUNDING ROCKET LAUNCHINGS AT CHURCHILL RESEARCH RANGE, SEPTEMBER 1964 ROCKET AD-II-58 AND AK-II-59**
F. V. Cairns and K. A. Steele Mar. 1965 62 p refs
(ERB-701) CFSTI: HC $3.00/MF $0.75

Some of the engineering aspects of the launching of two scientific sounding rockets, AD-II-58 and AK-II-59, in September 1964 are described. These launchings were part of a series sponsored by the National Research Council's Associate

Committee on Space Research for investigation of the aurora borealis. The main aspects of the launchings discussed here are: (1) planning of the payloads, (2) co-ordination of the assembly of the payloads which contained experiments contributed by geographically separated groups in the National Research Council and Canadian universities, (3) telemetry and other engineering parts of the payload, (4) launching of the rockets at Churchill Research Range, and (5) assessment of the engineering significance of the payload performance. The scientific results are published elsewhere by the scientists concerned. Author

**N66-14256*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SATELLITE SITUATION REPORT, VOLUME 5, NO. 20**
31 Oct. 1965 55 p
(NASA-TM-X-57062; X-537-65-217) CFSTI: HC $3.00/MF $0.50 CSCL 22B

A tabulation is given of objects in earth orbit. The data includes the code name, catalog number, source, launch date, minutes of period, inclination, apogee, perigee, and transmitting frequency. Decayed objects in orbit are also tabulated. C.T.C.

# 32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

**N66-13386#** Forest Products Lab., Madison, Wis.
**BUCKLING COEFFICIENTS FOR SANDWICH CYLINDERS OF FINITE LENGTH UNDER UNIFORM EXTERNAL LATERAL PRESSURE Progress Report**
E. W. Kuenzi, B. Bohannan, and G. H. Stevens Sep. 1965 28 p refs Revised
(Contract DO 33(615)65-5002; Buweps Order 19-65-8005 Weps)
(FPL-0104; ANC-23; AD-463425)

This note contains curves of buckling coefficients and formulas for the calculation of the critical external pressure of finite length, circular cylindrical shells with sandwich walls. The facings of the sandwich are isotropic, of equal or unequal thickness, of the same or different material, and their individual stiffness is not taken into account. The sandwich core is isotropic or orthotropic having natural axes in the axial, tangential, and radial directions of the cylinder. If the cores are very rigid, the method yields results that are substantially those of von Mises. Author

**N66-13393#** Naval Ordnance Test Station, China Lake, Calif.
**STRESS WAVE PASSAGE IN SELECTED ROCK FABRICS**
Carl F. Austin, Werner Goldsmith, and Stephen Finnegan Jun. 1965 69 p refs
(NAVWEPS-8734; NOTS-TP-3793; AD-618369) CFSTI: HC $3.00/MF $0.75

A study was made on the transmission and decay of pulses produced by impact in a very coarse-grained leucogranite, a fine-grained spessartite, and a fine-grained to aphanitic basalt. For most tests, ballistically suspended Hopkinson bars of these rock materials, 0.845 inches in diameter and 18 inches long, were subjected to longitudinal impact by 1/2-inch-diameter hardened steel spheres at an initial velocity of 3250 ±1.5% ips. Strain gages attached to the specimens at various stations recorded the shape and velocity of propagation of the resultant wave in the rock rod. Similar experiments were performed on an aluminum alloy rod of identical size to assess the magnitude of the dispersion resulting from the three-dimensional character of the rod. The nature of the pulse transformation during passage permits an assessment of the validity of various models proposed for geologic substances in the field of seismology. Static tests on virgin and shocked rods were generally found to agree with predicted effects of stress wave passage on the rock structure. These effects include compressive-strength loss in the impact end and tensile-strength loss in the distal end as the result of oriented fractures and a general lowering of the static Young's modulus. Author (TAB)

**N66-13408*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A STUDY OF CYCLIC PLASTIC STRESSES AT A NOTCH ROOT**
J. H. Crews, Jr. and H. F. Hardrath Westport, Conn., Soc. for Exptl. Stress Analysis [1965] 29 p refs Presented at the Soc. for Exptl. Stress Analysis Spring Meeting, Denver, 5-7 May 1965 *Its* Paper No. 963
(NASA-TM-X-56068) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An experimental study is presented for cylic plastic stresses at notch roots in specimens under constant-amplitude repeated tension and reversed loading. Edge-notched, $K_T = 2$, 2024-T3 aluminum-alloy sheet specimens were cycled until local stress conditions stabilized. Local stress histories were determined by recording local strain histories during cycling and reproducing these histories in simple unnotched specimens. The fatigue lives for these notched specimens were estimated using stabilized local stresses and an alternating versus mean stress diagram for unnotched specimens of the same material. These predictions compared favorably with lives from S-N data for the notch configuration tested. In addition, an expression is presented for calculating local first-cycle plastic stresses. An acceptable correlation is shown between predicted stresses and experimental data within the scope of the investigation. Author

**N66-13410*#** Lehigh Univ., Bethlehem, Pa. Inst. of Research.
**DETERMINATION OF THE SURVIVAL PROBABILITY OF A LAUNCH VEHICLE RISING THROUGH A RANDOM WIND FIELD**
Ferdinand P. Beer and William C. Lennox 15 Jan. 1965 27 p refs
(Grant NsG-466)
(NASA-CR-60830) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The problem of determining the survival probability of a vehicle through a statistical load survey was studied. It was assumed that failure of a component will occur if a critical value of the load is reached, and that the probability of survival of the component is the probability that the nonstationary random function $q(z)$ will not cross the level $q = \alpha$ over the interval $0 < z < z_m$, where $z_m$ is the maximum height reached by the vehicle. The probability of survival of the vehicle itself can then be obtained by forming the product of the survival probabilities of its components. Also discussed is a method that avoids the statistical load survey altogether by assuming that the launch vehicle constitutes a linear system and thus determines the vehicle survival probability from the statistical properties of the wind profiles. G.G.

**N66-13415*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME II: STRESSES AND DEFORMATIONS OF FIXED-EDGE SEGMENTAL CYLINDRICAL SHELLS Final Report**

E. Y. W. Tsui, F. A. Brogan, and P. Stern Jun. 1965 119 p refs (Contract NAS8-11480)

(NASA-CR-67730; LMSC-M-77-65-1) CFSTI: HC $4.00/MF $0.75 CSCL 20K

This volume present a set of basic equations for orthotropic thin elastic cylindrical shells and a digital program for the analysis of static response of segmental cylinders with fixed edges under the following loading conditions: linearly varying pressure, uniform pressure, and linear thermal gradient through the thickness of shell. The problem is solved numerically by means of finte-difference technique, using a direct method of solving a large system of simultaneous equations. Also, a numerical example showing the stresses and deformations of a segmental orthotropic cylinder under uniform pressure is presented. Author

**N66-13429#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**STABILITY OF A CYLINDRICAL PANEL ON AN ELASTIC FOUNDATION**

B. A. Korbut and L. G. Odnoral [1965] 5 p refs Transl. into ENGLISH from Soprov. Mater. i Teoriia Sooruzh. (USSR), no. 1, 1965 p 17–23

The stability of a cylindrical panel on an elastic foundation was investigated. The problem occurs in a complete cylindrical shell with an elastic filler reinforced by transverse and longitudinal force framing and where each cell of the shell is a panel on an elastic foundation. It is assumed that the panel is hinge supported along the contour by ribs which are absolutely stiff relative to bending. The panel edges may slide freely along the ribs. An elastic foundation of the Winkler type with a constant bedding coefficient is assumed. The shell under consideration is compressed by stresses directed along the generators. The upper and lower critical stresses are determined as a function of the panel curvature and the foundation stiffness. The problem is solved by the Ritz method. R.N.A.

**N66-13430#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**INFLUENCE OF BOUNDARY CONDITIONS ON THE STABILITY OF A CYLINDRICAL SHELL UNDER LONGITUDINAL IMPACT**

V. I. Borisenko [1965] 7 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 1, no. 8, 1965 p 57–62

The buckling of a cylindrical shell under longitudinal impact by a rigid mass with free, hinge support, and rigidly framed edge boundary conditions is investigated. The longitudinal shell vibrations are taken as the unperturbed state of the motion. The customary stability equations of linear shell theory are used as the equations of the perturbed motion. The Galerkin method and the Hurwitz criterion are used in investigating the stability of the solution of the original system. The results of calculations are included. R.N.A.

**N66-13432#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**CRITERIA OF THE NONLINEARITY OF PLATES**

Ia. D. Livshitz [1965] 6 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 1, no. 8, 1965 p 17–22 Presented at the All-Union Congr. on Theoret. and Applied Mech., Moscow, 1964

The imperfection of criteria for referring plates to some kind of category has been previously noted and a proposal made for taking specific numerical values of the nondimensional parameter

$$S = \frac{p}{E}\left(\frac{a}{h}\right)^4$$

as the nonlinearity criterion for rectangular plates, where p is the loading intensity, E the elastic modulus, and a and h the length of the smaller side and the plate thickness, respectively. The content and application of this proposed criterion is expanded and a refined method of analyzing flexible plates is explained, on whose basis limiting values of the criterion S, presented here for rectangular plates with different conditions on the contour and with different ratios of the lengths of the sides, have been calculated. The limiting values of S, which when exceeded require the analysis of plates by nonlinear theory, are established by means of stresses and displacements. R.N.A.

**N66-13443#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**FLUTTER OF A THIN ELASTIC SUPPORTED RECTANGULAR PLATE UNDER THE EFFECT OF SHEARING AND COMPRESSIVE EDGE LOADING**

A. P. Mikhailov [1965] 3 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 4, 1965 p 129–130

A numerical investigation was conducted on the vibration frequencies of a rectangular supported plate in a supersonic flow with shear and a compressed-strained plate in the middle plane. The influence of the shearing forces on the critical flutter velocity of the plate is estimated as well as the dependence of this velocity on the transverse tightening and some other parameters of the problem. R.N.A.

**N66-13446#** Catholic Univ. of America, Washington, D. C. School of Engineering and Architecture.

**EXPERIMENTAL DETERMINATION OF STRESSES AND STRAINS IN A RECTANGULAR PLATE BONDED ON THE TWO LONG EDGES AND SUBJECTED TO BIAXIAL RESTRAINED SHRINKAGE**

A. J. Durelli, V. J. Parks, and P. Bhadra Oct. 1965 28 p refs (Contract AF 04(611)-10378)

(PR-4; AD-472573)

Two long edges of a rectangular plate are bonded to a rigid frame. Shrinkage of the plate is completely restrained longitudinally, and partially restrained transversally. The stresses and strains are determined by using photoelasticity. Author

**N66-13466#** Stanford Univ., Calif. Div. of Engineering Mechanics.

**STRESSES IN AND DEFORMATION OF A PRESTRESSED VERY THIN SHELL SUBJECT TO ADDITIONAL LOAD Final Report**

W. Flugge 28 Oct. 1965 12 p (Contract DA-31-124-ARO(D)-42)

(AROD-3065-3; AD-473605)

The subject of the project was the investigation of thin shells, which are inflated by a pressure high enough to cause a large deformation. Such balloons present two stress problems: (1) to find the deformation caused by the inflating pressure or, if the shape of the inflated shell is known, to find out how it deforms when the internal pressure is partially or completely

removed, and (2) to use the remarkable stiffness of the inflated (prestressed) shell to make it carry some additional load of an arbitrary kind. Author (TAB)

**N66-13471#** Forest Products Lab., Madison, Wis.
**MINIMUM WEIGHT STRUCTURAL SANDWICH**
Edward W. Kuenzi Oct. 1965 15 p refs Revised Issued in Cooperation with Mil-HDBK-23 Working group on Composite Construct. for Flight Vehicles of the AF, Navy, and Commerce Dept.
(Contract AF 33(657)-63-358; Buweps Order IPR 19-64-8041-Weps)
(FPL-086, Rev.; AD-473673)

This note presents theoretical analysis for determination of demensions of structural sandwich of minimum weight that will have certain stiffness and loadcarrying capabilities. Included is a brief discussion of the resultant minimum weight configurations. Author (TAB)

**N66-13478*#** National Aeronautics and Space Administration, Washington, D. C.
**LIMIT EQUILIBRIUM OF NON-HOMOGENEOUS PLATES AND ROTATION SHELLS WITH PIECE-WISE LINEAR PLASTICITY CONDITIONS**
Yu. P. Listrova and M. A. Rudis Dec. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 2, 1965 p 88–94
(NASA-TT-F-9453) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The limit equilibrium for plates and rotation shells at any piece-wise linear yield conditions is examined. A parametrical description is given of hypersurface yield for symmetrically loaded rotation shells made of rigid plastic material and complying with the yield condition of a maximal tangential load or with the yield condition of a maximal corrected load. It is assumed that the yield limit changes linearly with respect to shell thickness. As an example, the limit equilibrium of a spherical shell acted on by an equally distributed internal pressure is examined. R.N.A.

**N66-13479*#** National Aeronautics and Space Administration, Washington, D. C.
**CURVATURE OF SPHERICAL SHELL UNDER THE INFLUENCE OF CONSTANT ASYMMETRIC LOAD [IZGIB SFERICHESKOY OBOLOCHKI POD DEYSTVIYEM PROIZVOL'NOY OSESIMMETRICHNOY NAGRUZKI]**
T. V. Budnikova Dec. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 2, 1965 p 154–159
(NASA-TT-F-9454) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The curvature of a spherical shell under the influence of a constant asymmetric load arbitrarily changing along the meridian with a sliding sealing of the rim is examined. As an example, a problem of shell loading by m concentric circumferences of normal constant intensity load is solved. Under ordinary methods of calculation this type of problem is reduced to the solution of a system of algebraic equations of the 4(m + 1)-th order, which represent the boundary conditions and the conditions of conjugation of individual sections of the shell. To avoid this, it is proposed that Meissner equations be solved in a form of expansions in eigenfunctions satisfying the boundary conditions. R.N.A.

**N66-13498*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**INTERFACES BETWEEN FATIGUE, CREEP, AND FRACTURE**
S. S. Manson [1965] 88 p refs Presented at the Intern. Conf. on Fracture, Tohoku Univ., Sendai, 12 Sep. 1965
(NASA-TM-X-57035) CFSTI: HC $3.00/MF $0.75 CSCL 20K

A detailed discussion is presented on the interfaces between fatigue, creep, and fracture. Three subjects are examined. The first is the interface between fatigue and fracture which concerns the fatigue problem of quasi-brittle materials. The second is an attempt to bring together creep and fatigue by considering fatigue in the creep range at elevated temperatures. The third deals with cumulative fatigue damage which is a process of initiating and propagating a crack and is considered as a second interface between fatigue and fracture. R.N.A.

**N66-13519*#** AVCO Corp., Nashville, Tenn. Aerospace Structures Div.
**OPTIMIZATION OF SATURN IB AND V MOUNTING AND THERMAL CONDITIONING PANELS Final Report**
D. L. Manor 18 Oct. 1965 55 p With drawing no. 2-10086
(Contract NAS8-11870)
(NASA-CR-68697; R-1051) CFSTI: HC $3.00/MF $0.50 CSCL 22B

Various means of reducing the weight of the Saturn IB and V mounting and thermal conditioning panel while maintaining its structural properties were studied. Two modified test panels incorporating a coolant fitting design underwent dynamic testing. One panel designed with inverted optimized inserts successfully passed all phases of dynamic testing; the other cracked in the brazement outer skin during vibration testing. A third panel was constructed with inverted optimized inserts under deletion of the lightening holes and was also successfully dynamically tested. This final optimized panel design presented a weight reduction of approximately 24.5 percent from the original design concept. An additional weight reduction of 5.564 pounds per panel was obtained by reducing the material thickness of the various panel components resulting in total weight savings of 6.74 pounds per panel. Appendices contain the test data and safety calculations for the various insert designs. G.G.

**N66-13535#** Institut Franco-Allemand de Recherches, St. Louis (France).
**VISUALISATION OF WAVE PROPAGATION IN IMPULSE-LOADED BARS**
E. David, R. Schall, and H. Schardin 23 Feb. 1963 19 p refs
(ISL-T-20/63) CFSTI: HC $1.00/MF $0.50

Various experimental techniques which can be used for the visualization of stress waves are considered and their applicability to the study of wave propagation in bars is discussed. Some experimental results which were obtained by means of shadow photography are given. These were obtained with bars immersed in water and show the existence of precursor waves which travel with the velocity of propagation in an unbounded medium. A qualitative theory of the wave system is outlined and it is shown that the concept of group velocity in terms of the Pochhammer-Chree treatment leads to some difficulties in this problem. A second investigation using a different method of visualization, namely flash radiography is also described. This technique has here been used for studying the passage of intense plastic waves in rods. Author

**N66-13539#** Institut Franco-Allemand de Recherches, St. Louis (France).
**STUDY OF IMPACT AT HIGH VELOCITY [ETUDE D'IMPACTS A GRANDE VITESSE]**
C. Lacomte 13 Nov. 1963 50 p refs In FRENCH
(ISL-T-27/63) CFSTI: HC $2.00/MF $0.50

Hypervelocity impact studies are reported in three areas: (1) impacts on very thick targets; (2) impacts on very thin targets; and (3) impacts on targets protected by a thin film. Both Duralumin and polyethylene were used as projectiles and targets. A study was made of crater shape and size as functions of projectile shape, angle of attack, and distance travelled. Transl. by D.T.

**N66-13545#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**PERTURBATION METHOD IN THE THEORY OF SMALL DEFLECTIONS OF NONLINEARLY-ELASTIC PLATES**
Iu. K. Chekushkin [1965] 8 p refs Transl. into ENGLISH from Soprot. Mater. i Teoriia Sooruzh (USSR), no. 1, 1965 p 51–61

Fundamental relationships and equations for the theory of small deflections of nonlinear-elastic plates are evaluated. The perturbation method is used to find the normal and tangential stresses and the bending moments and torques. Example calculations for cylindrical bending of copper, pure copper, aluminum bronze, and steel materials are shown in graphs depicting the deflection-loading, and stress-loading values. It was concluded that the nonlinearity effect is manifested in an increase in deflection and a decrease in stress as compared with the deflections and stresses calculated by linear theory. G.G.

**N66-13547#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**NATURAL VIBRATIONS OF ELLIPTICAL PLATES AND MEMBRANES**
V. S. Gontkevich [1965] 4 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 1, no. 9, 1965 p 115–118

Natural vibration frequencies of elliptical plates and membranes were studied. Vibration equations and boundary conditions of the elliptical coordinates were computed, and the plate vibration modes were symmetrically related to both axes of the ellipse. An approximation method using the lowest modes to find the eigenvalues of the membranes and plates was used to obtain a solution near which the desired frequencies lie above and below (in a ±5% range). G.G.

**N66-13549#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**PROPAGATION OF VISCOELASTIC-PLASTIC WAVES IN A ROD OF VARIABLE SECTION**
S. A. Leonov [1965] 5 p refs Transl. into ENGLISH from Prikl. Mat. i. Mekh. (Moscow), v. 1, no. 3, 1965 p 123–127

The problem of viscoelastic-plastic wave propagation in a constant cross-section rod of material whose strain law under impulse loading is known, was analyzed. The linearized strain law was used to obtain a solution for the case that the end plate of the rod in a state of rest is suddenly loaded by some constant stress. G.G.

**N66-13588#** Lehigh Univ., Bethelem, Pa. Fritz Engineering Lab.
**WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS. FURTHER STUDIES ON THE LATERAL-TORSIONAL BUCKLING OF STEEL BEAM-COLUMNS**
Theodore V. Galambos, Peter F. Adams, and Yuhshi Fukumoto Feb. 1965 52 p refs
(Contracts NObs-90041; NBY-53160)
(Rept.-205A.36; AD-613074) CFSTI: HC $3.00/MF $0.50

In this report solutions are presented for the inelastic lateral-torsional buckling strength of as-rolled steel wide-flange beam-columns. The beam-columns are subjected to an axial force and the bending moments applied either at one end of the member only or equally to both ends. The reduction in strength as compared with the optimum performance of the member is examined and the influence of the cross-section size, yield stress level, and residual stress level on the lateral-torsional buckling strength is determined. The theoretical solutions are then compared with an empirical reduction formula which is proposed for design purposes. Available test results are compared with the theory as represented by this reduction formula. Author (TAB)

**N66-13630#** Assembly Products, Inc., Chesterland, Ohio.
**PRODUCTION ENGINEERING MEASURE FOR METERS, TAUT-BAND SUSPENSION A-C MOVING IRON VANE PER SIGNAL CORPS REQUIREMENTS SCS-160 Quarterly Progress Report, Feb. 1–Apr. 30, 1965**
R. H. Nichols [1965] 7 p
(Contract DA-36-039-AMC-01473(E))
(QPR-8; AD-621211) CFSTI: HC $1.00/MF $0.50

Problems previously reported in the Moisture Resistance, Thermal Shcok and High Impact Shock tests have been resolved. Performance on Group V tests has verified that a taut band suspension has been evolved which will withstand the shock test with no immediately apparent detrimental effects. Band breakage during vibration has been greatly reduced as the result of the conclusions of a large scale study of band breakage reported last quarter. Isolated failures due to band breakage during vibration have occurred however. All design work is essentially complete. Tooling has been completed for nearly all parts. Testing was concluded in the selection of the steel alloy for the iron vanes. Work on refining equipment and production problems was performed on a number of parts after initial samples from the tooling were received. Author (TAB)

**N66-13648*#** Dynamic Science Corp., Monrovia, Calif.
**ANALYSIS AND DESIGN OF ELASTO-PLASTO-VISCOUS POINT VIBRATION DAMPERS Final Report**
Jerry C. Peck 22 Oct. 1965 137 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951099)
(NASA-CR-68787; SN-62) CFSTI: HC $4.00/MF $1.00 CSCL 20K

The purpose of this investigation is the development of theoretical analysis and design techniques for point vibration dampers whose basic energy-absorption mechanism is elasto-plastic hysteresis, supplemented by rubber damping elements. The properties of metals under cyclic plastic deformation are presented, based mainly on the low-cycle fatigue literature. Three damper configurations are investigated: beams, coil springs, and torsion bars. Relations between weight, damper properties, and material properties are obtained on the basis of yield point behavior. Dimensionless force-deflection relations in the post-yield region are obtained using power-law approximations. The steady-state nonlinear one-degree-of-freedom vibration response is obtained using the approximate "method of slowly varying parameters." A one-degree-of-freedom approximation to the resonant response of multimode systems is presented. Methods for applying the dimensionless vibration response results to specific design problems are given. Finally, the above techniques are applied to the isolation problem of a solar panel. Author

**N66-13692#** Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
**SYMMETRIC DEFORMATION OF A RADIALLY-CONSTRAINED THIN CIRCULAR RING UNDER INERTIA LOADING**

L. L. Bucciarelli, Jr. and T. H. H. Pian Jul. 1965 34 p refs
(Grant AF-AFOSR-347-64)
(ASRL-TR-127-1; AFOSR-65-1619; AD-622150) CFSTI: HC $1.00/MF $0.50

This paper presents a derivation of the equations governing the elastic deformation of a thin circular ring which is acted upon by inertia loading along a direction in the plane of the ring. The ring is constrained such that no radial outward displacements are permitted. The resulting system of nonlinear equations are reduced to a convenient form which enables the application of a systematic iterative scheme for its solution. Analysis of a ring of a thickness-radius ratio of 0.01 is made. The snap-buckling behavior of the ring is indicated by a load-deflection curve. The paper also provides a simple linear analysis which is applicable to the calculation of the initial portion of the load-deflection curve. TAB

**N66-13719#** Brown Univ., Providence, R. I. Div. of Engineering.
**ON THE BEHAVIOR OF ELASTIC PLASTIC TRUSSES CONTAINING UNSTABLE ELEMENTS Technical Report No. 43**
G. Maier Apr. 1965 49 p refs
(Contract Nonr-562(20))
(Nonr-562(20)/43; AD-621707)

Sufficient conditions for uniqueness of incremental response and overall stability are established and discussed for elastic plastic trusses containing unstable members. These criteria consist in the positive definiteness of matrices built up with the elastic influence coefficients of axial forces for dislocations and with the plastic compliances of the members at the yield point. All conditions are proved to be weaker than the usual demand of local stability, for all redundant structures. Normality of the incremental plastic displacement vector in load-space is shown to hold, irrespective of instability, nonlinearity in the elastic range and changes of the elastic behavior due to plastic strains. Convexity of the loading surfaces is also briefly discussed, with special reference to the case of nonlinear elastic responses of some members. Author (TAB)

**N66-13763#** IIT Research Inst., Chicago, Ill. Dept. of Mechanics.
**PLASTIC ANALYSIS OF RIB-REINFORCED CYLINDRICAL SHELLS**
Andre Biron and Antoni Sawczuk Jul. 1965 26p refs
(Contract Nonr-140604)
(DOMIIT-1-29; AD-622508) CFSTI: HC $2.00/MF $0.50

Using the strain mapping method for the Tresca yield condition, the yield surface is derived for a cylindrical shell with a wall reinforced by longitudinal ribs on one side. Results are given for the case where the axial load is zero. As a sample problem utilizing this surface and an appropriate method of solution of non-linear equations, the exact plastic solution of a cantilever shell under constant pressure is obtained.
Author (TAB)

**N66-13764#** Minnesota Univ., Minneapolis. Dept. of Aeronautics and Engineering Mechanics.
**MEASUREMENT OF COMPLEX SHEAR MODULUS OF THIN VISCOELASTIC LAYERS**
H. E. Miller, J. L. Jurgens, and R. Plunkett Oct. 1965 24 p refs
(Contract Nobs-92285)
(TR-65-4; AD-623059) CFSTI: HC $1.00/MF $0.50

A method was developed for measuring the complex shear modulus of thin viscoelastic layers of adhesive using standard mechanical impedance equipment. The measurement is direct and the data can be quickly obtained once the environmental factors are fixed. It was found that the effective shear modulus of the adhesive as used in this test is much less than that of the material itself although the loss tangent is about the same. It was also found that transverse strain did not affect the true shear modulus, even for transverse extensions as large as 100%.
Author (TAB)

**N66-13797#** Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
**STRESS INTENSITY FACTORS FOR SINGLE EDGE CRACKS IN RECTANGULAR SHEET WITH CONSTRAINED ENDS**
Oscar L. Bowie and Donald M. Neal Aug. 1965 21 p refs
(AMRA-TR-65-20; AD-622781) CFSTI: HC $1.00/MF $0.50

The stress intensity factors at the crack roots for single edge cracks in a rectangular sheet with constrained ends are considered. The stress analysis for this mixed boundary problem is carried out using conformal mapping and complex variables. Numerical results are obtained for varying crack lengths and length-to-width ratios of the sheet over a range considered of practical interest for the use of short test specimens. Author (TAB)

**N66-13821#** Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
**STRUCTURAL INSTABILITY INDUCED BY CREEP Technical Report No. 14**
Robert L. Carlson Sep. 1965 25 p refs
(Contracts Nonr 225(30); Nonr-225(47))
(SUDAER-244; AD-622834) CFSTI: HC $1.00/MF $0.50

The application of the linearized theorized of Robotnov and Shesterikov and of Onat and Wang to creep buckling is examined and an investigation of the associated disturbance-response behavior is made. It is shown that a precise and consistent criterion for stability that has both theoretical and experimental support is possible within the scope of linearized theory. The linearization procedure of Onat and Wang is extended to multiaxial stress states and the problem of a compressively loaded rectangular plate subject to creep is analyzed. Author (TAB)

**N66-13836*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME IV: STRESSES AND DEFORMATIONS OF FIXED-EDGE SEGMENTAL SPHERICAL SHELLS Final Report**
E. Y. W. Tsui, C. T. Chen, and P. Stern Jul. 1965 139 p refs
(Contract NAS8-11480)
(NASA-CR-68766; LMSC-M-77-65-4) CFSTI: HC $4.00/MF $1.00 CSCL 20K

This report presents a set of basic equations for thin elastic spherical shells and a digital program for the analysis of the static response of segmental spherical shells with fixed edges under the following loading conditions: uniform pressure, linear thermal gradient through the thickness of shell. The problem is solved numerically by means of finite-difference technique, using a direct method of solving a large system of simultaneous equations. A numerical example showing the stresses and deformations of a spherical sector under uniform pressure is also presented. Author

**N66-13837*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME III: STRESSES AND DEFORMATIONS ON FIXED-EDGE SEGMENTAL CONICAL SHELLS Final Report**

E. Y. W. Tsui, J. M. Massard, and P. Stern Jun. 1965 126 p refs
(Contract NAS8-11480)
(NASA-CR-68774; LMSC-M-77-65-2) CFSTI: HC $4.00/MF $1.00 CSCL 20K

This volume presents a set of basic equations for thin elastic conical shells and a digital program for the analysis of static response of segmental conical shells of linearly varying thickness with fixed edges under the following loading conditions: uniform pressure, gravitational loading, linear thermal gradient through the thickness of shell. The problem is solved numerically by means of finite-difference technique, using a direct method of solving a large system of simultaneous equations. Author

**N66-13876#** Naval Research Lab., Washington, D. C.
**REVIEW OF CONCEPTS AND STATUS OF PROCEDURES FOR FRACTURE-SAFE DESIGN OF COMPLEX WELDED STRUCTURES INVOLVING METALS OF LOW TO ULTRA-HIGH STRENGTH LEVELS**
W. S. Pellini, R. J. Goode, P. P. Puzak, E. A. Lange, and R. W. Huber Jun. 1965 89 p refs
(NRL-6300; AD-619574) CFSTI: HC $3.00/MF $0.75

The report presents integrated analyses and substantiating data on problems of metallurgical optimization and solutions to fracture-safe design and fabrication of large welded structures, utilizing high strength metals. The apparent complexities of attaining practical engineering use of high strength metals derive primarily from lack of appreciation of the close interrelationships that exist between the intrinsic susceptibilities of these metals to various failure modes and the intrinsic structural mechanics features of the structures. Metals of high intrinsic resistance to failure may be matched to structures of high intrinsic design complexity and ordinary fabrication techniques with assurance of structural safety. Metals of low intrinsic resistance to failure must be matched only to structures that are exactly stress analyzable and thereby are restricted to designs of the utmost attainable simplicity and to fabrication by techniques of utmost attainable simplicty and to fabrication by techniques of utmost precision. TAB

**N66-13880#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**REFINEMENT OF THE UPPER CRITICAL LOADING OF PIPE BENDING, TAKING ACCOUNT OF THE GEOMETRIC NONLINEARITY**
E. L. Aksel'rad [1965] 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1965 p 133–139

The critical bending moment is defined as the moment causing the formation of dents in the tube deformed by subcritical bending. The mode which the pipe assumes under subcritical elastic bending and the corresponding stresses are considered taking into account the nonlinear dependence on the bending moment. The upper critical loading is defined as the point of bifurcation of the nonlinear solution. R.N.A.

**N66-13887#** RAND Corp., Santa Monica, Calif.
**FACE WRINKLING MODE OF BUCKLING OF SANDWICH PANELS**
T. C. Fan Aug. 1965 6 p refs
(P-3202; AD-619997) CFSTI: HC $1.00/MF $0.50

Several suggestions are presented to help understand the face wrinkling mode of buckling of sandwich panels. Since facings usually deform more than their thickness in the wrinkling mode, a large deflection criterion indicates that it would be appropriate to include the nonlinear effect in the calculation of beam curvature. The assumption of the linear elastic support provided by the core in wrinkling may require certain modification for relatively deep cores. In addition to using the results from a long and short beam technique for the measurement of shear moduli, the findings from a block shear test may be used for comparison to establish a more reliable value for the core shear modulus. R.N.A.

**N66-13918#** Sandia Corp., Albuquerque, N. Mex.
**TRANSIENT RESPONSE OF LINEAR DAMPED LUMPED SPRING-MASS SYSTEMS BY EXPERIMENTALLY DERIVED TRANSFER FUNCTIONS**
R. W. Kelley Mar. 1965 59 p refs
(Contract AT(29-1)-789)
(SC-TM-64-1772)

The application of experimentally derived transfer functions to purely mechanical systems is investigated. The transfer function for a mechanical model, intended to represent a viscously damped single-degree system, is experimentally derived by subjecting the mechanical model to steady-state sinusoidal vibration and utilizing the resulting Bode plots. This experimental transfer function is used to predict the transient response to a mechanical shock pulse. The suitability of this experimental transfer function is investigated by comparing the response with the theoretical response of the idealized system and with the actual response of the model to a mechanical shock pulse. A discussion is presented on methods of improving the experimental transfer function by utilizing the amplitude and phase plots. Author (NSA)

**N66-13952#** Rocketdyne, Canoga Park, Calif.
**MICROMECHANICS OF FIBER-REINFORCED COMPOSITES Technical Report, Jul. 1, 1964–Jun. 30, 1965**
E. L. Alexander, A. A. Caputo, M. E. Prado, and J. E. Hilzinger Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1965 147 p refs
(Contract AF 33(615)-1627)
(AFML-TR-65-283; AD-623644) CFSTI: HC $5.00/MF $1.00

Research on the micromechanical behavior of composites reinforced with boron and other fibers is reported. A wide variety of reinforcing elements were used in photoelastic matrix materials to form beams, plates, and three-dimensional microspecimens of varied configurations. The effects of reinforcing element modulus and elongation were investigated in beams in four- and three-point loading. The degree of stiffening derived from various filament reinforcing materials was defined, and different failure mechanisms were investigated. Reinforced plates were biaxially tested, and fiber unbonding, buckling, and the subsequent stress redistribution were observed photoelastically. Significant advances in microphotoelasticity are reported. Very small specimens were loaded, and sharp microscopic photoelastic stress patterns (including induced flaw points) were photographed. The filament configurations represent typical laminate geometries, and small flaws were seen to have a remarkably wide field of influence. Author (TAB)

**N66-13954#** Oklahoma Univ. Research Inst., Norman.
**DYNAMIC ELASTIC, DAMPING, AND FATIGUE CHARACTERISTICS OF FIBERGLASS-REINFORCED SANDWICH STRUCTURE Final Report**
Gene M. Nordby, W. C. Crisman, and Charles W. Bert Ft Eustis, Va., Army Aviation Matter. Labs., Oct. 1965 95 p refs
(Contract DA-44-177-AMC-164(T))
(USAAVLABS-TR-65-60; AD-623128) CFSTI: HC $3.00/MF $0.75

Research was conducted to determine the basic dynamic properties of fiberglass-reinforced plastic (FRP) sandwich structure suitable for use as a primary airframe structural material. The research program was carried out in two separate parts: (A) determining dynamic moduli and damping, and (B) determining fatigue behavior. In each part, two types of hexagonalcell honeycomb core materials were investigated: 5052 aluminum foil and HRP (heat resistant phenolic) fiberglass. Author (TAB)

**N66-13956#** Texas Univ., Austin. Structural Mechanics Research Lab.

**A STUDY OF THE INTERACTION OF CUSHIONING MATERIALS AND STRUCTURAL ELEMENTS**

Mansour Nikkhah, Ned H. Burns, and J. Neils Thompson Jul. 1965 90 p refs

(Contract DA-22-079-ENG-393)

(AD-623327) CFSTI: HC $3.00/MF $0.75

The study extends the scope of previous investigations of the energy-dissipating characteristics of vermiculite concrete. Emphasis was given to interaction effects of a cushioning material and a structural element, and the behavior of materials to different dynamic loading systems. An experimental program was conducted on vermiculite concrete to simulate the interaction of a structural element and a cushion. Two different methods of applying dynamic loads were utilized in the study. To apply the results of the energy-dissipating materials studies to actual structural analysis, an analytical solution utilizing a numerical integration solution was employed. If the load pulse to which a structure is subjected and the resistance of the structure to motion due to this load are known or can be reasonably determined, this method of analysis can be used to predict the deflection response of the structure. Comparison of measured and predicted deflection responses for simple beams studied showed good agreement. Author (TAB)

**N66-13958#** Tennessee Univ., Knoxville. Engineering Experiment Station.

**EXPERIMENTAL STRESS ANALYSIS OF THE ATTACHMENT REGION OF HEMISPHERICAL SHELLS WITH RADIALLY ATTACHED NOZZLES**

R. L. Maxwell, R. W. Holland and J. A. Cofer Jun. 1965 542 p Prepared for Union Carbide Nucl. Co.

(Contract W-7405-ENG-26)

(ME-7-65-1; TID-22134) CFSTI: HC $8.41/MF $3.25

Stress patterns were determined for six nozzle configurations for the following five types of loadings: internal pressure, axial load on nozzle, pure bending moment on nozzle, shear load on nozzle, and pure torque on nozzle. The nozzle radius-to-thickness ratio was varied from 4.75 to 21, but the hemisphere ratio was kept constant at 40.85. NSA

**N66-13962#** Battelle Memorial Inst., Columbus, Ohio.

**ANALYSIS OF INFORMATION ON REINFORCED OPENINGS IN PRESSURE VESSELS Phase Report, 12 Feb. 1963–11 Feb. 1964**

E. C. Rodabaugh and T. J. Atterbury 22 Feb. 1964 80 p refs

(Contract W-7405-ENG-92)

(BMI-X-276)

Progress is reported on the analysis of information on reinforced openings in pressure vessels. Among the significant major results was that comparison of test data on cylinder-to-sphere connections with Waters' shell theory indicated that the shell theory gives reasonably good stress-magnitude predictions for connections with an external fillet radius approximately equal to the cylinder wall thickness and for connections with uniform-wall pad reinforcing on the cylinder or shell under certain conditions. Modifications to the shell theory to compensate for local thickness variation in the intersection area, stress concentrations, and thick-wall effects, can be used to provide generally more accurate stress predictions. Stresses in cylinder-to-sphere connections with a significant amount of relatively compact, local reinforcing cannot be accurately predicted by the use of shell theory or by semi-empirical modifications to the shell theory. A computer program can be used to provide reasonable predictions of stresses, provided the section thickness changes are not too abrupt. E.E.B.

**N66-13981#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

**EXPERIMENTAL METHODS FOR DETERMINING SHEAR MODULUS OF FIBER REINFORCED COMPOSITE MATERIALS Technical Report, Jul.–Dec. 1964**

J. M. Hennessey, James M. Whitney, and M. B. Riley Sep. 1965 54 p refs

(AFML-TR-65-42; AD-623316) CFSTI: HC $3.00/MF $0.75

The report presents four acceptable methods for determining the shear modulus of orthotropic materials. Two methods are appropriate for determining in-plane shear modulus and two others are for determining 'bending' shear modulus which is applicable in calculating buckling loads of laminated plates and shells. A discussion of each method precedes the method of experimental determination. The derivation of all pertinent equations, are presented. TAB

**N66-14002#** Aerospace Corp., San Bernardino, Calif. Technology Div.

**PREDICION OF RE-ENTRY VIBRATION**

Frank A. Smith and Frederick J. Benedetti Sep. 1965 29 p refs

(Contract AF 04(695)-669)

(TDR-669(S6810-21)-1; BSD-TR-65-453; AD-623081) CFSTI: HC $2.00/MF $0.50

The underlying problem in the prediction of re-entry vibrations is the fundamental question regarding the effectiveness of the boundary layer noise to produce structural vibrations, particularly during flight at velocities up to Mach 20. Although the pressure fluctuations in the boundary layer are thought to be larger during the re-entry period than boost, this effect is cancelled, in part, by the increased velocities which distributes the energy over a much broader frequency bandwidth (up to 100 kc). Thus, for the frequency range of interest (up to 2000 cps), the predicted vibration criteria may vary by as much as ten decibels between any two analysts, depending upon how these factors are treated. This paper presents, in nondimensional form, recent broadband vibration data which indicates a trend toward higher vibration levels during the re-entry period as compared to the boost period. The data are as yet insufficient both in quantity and quality to accurately assess the effect on vibration levels of all flight parameters (such as effects due to various ablative materials); however cursory checks of these data show that they tend to follow the dynamic pressure characteristics. TAB

**N66-14051*#** Space Technology Labs. Inc., Redondo Beach, Calif.

**IMPROVED ANALYTIC LONGITUDINAL RESPONSE ANALYSIS FOR AXISYMMETRIC LAUNCH VEHICLES. VOLUME I: LINEAR ANALYTIC MODEL**

J. S. Archer and C. P. Rubin Washington, NASA, Dec. 1965 164 p refs
(Contract NAS1-4351)
(NASA-CR-345) CFSTI: HC $5.00/MF $1.00 CSCL 20K

An improved linear analytical model and digital program developed for the calculation of axisymmetric launch vehicle steady-stage response to applied axisymmetric sinusoidal loads is described. The stiffness and mass matrices for the complete launch vehicle are obtained by superposition of the stiffness and mass matrices of the individual shell, and fluid and spring-mass components which are computed using a Rayleigh-Ritz approach. Fluid motions are assumed to be consistent with the shell component distortions. Also mentioned are methods for computing the dynamic response, computer program arrangement, and detailed requirements for the computer program. R.W.H.

**N66-14052*#** Space Technology Labs., Inc., Redondo Beach, Calif.
**IMPROVED ANALYTIC LONGITUDINAL RESPONSE ANALYSIS FOR AXISYMMETRIC LAUNCH VEHICLES. VOLUME II: COMPUTER PROGRAM DESCRIPTION**
C. P. Rubin and T. T. Wang Washington, NASA, Dec. 1965 143 p ref
(Contract NAS1-4351)
(NASA-CR-346) CFSTI: HC $4.00/MF $1.00 CSCL 20K

An improved linear analytical model for the calculation of launch vehicle steady state response to applied sinusoidal loads acting in the longitudinal direction is discussed. The present approach utilizes a finite element technique to construct the total launch vehicle stiffness and mass characteristics by subdividing the prototype structure into a consistent set of (1) axisymmetric shell components; (2) fluid components; and (3) mass spring components. The steady state response due to simple harmonic loads is determined by a standard modal response procedure which expresses the total displacement, velocity, acceleration and stress response as the linear superposition of the individual modal responses based on an assumed modal damping. R.W.H.

**N66-14055*#** National Aeronautics and Space Administration, Washington, D. C.
**STRESS CONCENTRATION ABOUT CURVILINEAR HOLES IN PHYSICALLY NONLINEAR ELASTIC PLATES [KONTSENTRATSIYA NAPRYAZHENIY OKOLO KRIVOLINEYNYKH OTVERSTIY V FIZICHESKI NELINEYNOY UPRUGOY PLASTINKE]**
A. N. Guz', G. N. Savin, and I. A. Tsurpal Jan. 1966 16 p refs Transl. into ENGLISH from Arch. Mech. Stosowanej (Poland), v. 16, no. 4, 1964
(NASA-TT-F-408) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An approximate solution method of plane physical nonlinear problems of stress concentration about curvilinear holes in thin plates made of a material subject to a nonlinear law of elasticity is given. The solutions are represented in the form of expansions in the small parameter $\mu$ and $\epsilon$. The determination of the stress function F for a physically nonlinear elastic plate with a hole reduces for each approximation to the integration of nonlinear differential equations. Stress concentration about an elliptic hole is considered in zero, first, and second approximation. The coefficient of stress concentration k is found on the contour of the hole, depending nonlinearly on the tensile forces P, the ellipticity of the hole, and a parameter $\lambda$ characterizing the mechanical properties of the material. Tables represent the values of the coefficient of stress concentration for various values of the parameters P, $\lambda$, and $\epsilon$. Author

**N66-14056*#** National Aeronautics and Space Administration, Washington, D. C.
**FORMULATION OF PROBLEMS OF FINDING STRESS FUNCTIONS WITH THE AID OF BIHARMONIC POTENTIALS [POSTANOUKA ZADACH OB OTYSKANII FUNKTSIY NAPRYAZHENIY S POMOSHCH'YU BIGARMONICHESKIKH POTENTSIALOV]**
Yu. D. Kopeykin Jan. 1966 10 p refs Transl. into ENGLISH from Prikl. Mekhan., Otd. Mat., Mekhan. i Kibernetiki (Kiev), v. 1, no. 2, 1965 p 104–109
(NASA-TT-F-409) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A general solution for the equation of statics of an elastic body in the presence of volume forces, in the form of biharmonic volume potentials, is derived. Discontinuity formulas for the limiting values of derivatives of volume potentials for single and double layers, at various points of the body surface are presented, based on the fundamental solution of the biharmonic equation $\zeta + r/2$. Author

**N66-14058*#** National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
**PRACTICAL LIMITS FOR BALSA IMPACT LIMITERS**
Don Bresie Washington, NASA, Jan. 1966 18 p refs
(NASA-TN-D-3175) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The maximum impact velocity criterion is developed for the spherical, hard-landing payload of a planetary probe which uses a balsa impact limiter. The equations presented represent refinements to previous work of various authors. The curves allow conceptual designers to define reasonable values of allowable impact velocity for a given weight and volume of the total package. Author

**N66-14141#** North Carolina State Coll., Raleigh. Applied Mathematics Research Group.
**A BOUSSINESQ PROBLEM FOR A FINITE CYLINDER**
David B. Teague May 1965 86 p refs
(Grants AF-AFOSR-444-64; NSF GK-59; Contract AF 49(628)-1271)
(AFOSR-65-1328; AD-622525) CFSTI: HC $3.00/MF $0.75

A Boussinesq problem for a finite clamped cylinder is reduced to a Fredholm integral equation of the second kind with a symmetric kernel using the method of Sneddon Srivastav. A simple approximate solution for the integral equation is obtained. This solution is accurate to within 3% provided the ratio of the radius of contact of the punch to the radius of the cylinder is less than one-half. Formulas are derived for the normal stress and displacement components, total force on the punch, and penetration of the tip of the punch as quadratures of the solution of the integral equation which are accurate to within 1% provided the ratio of length to radius of the cylinder is greater than unity. The accuracy of all final results is within 4% because of the accuracy of the solution of the integral equation. If the ratio of radius of contact of the punch to the radius of the cylinder is 0.1 or less, the results differ only slightly from the known solutions for the infinite half space. Author (TAB)

**N66-14180#** California Inst. of Tech., Pasadena. Div of Engineering and Applied Science.
**MINIMUM ENERGY CHARACTERIZATIONS OF SAINT-VENANT'S SOLUTION TO THE RELAXED SAINT-VENANT PROBLEM**
Eli Sternberg and James K. Knowles Aug. 1965 35 p refs
(Contract Nonr-220(58))
(TR-3; AD-622502) CFSTI: HC $2.00/MF $0.50

This investigation aims at minimum strain-energy characterizations of Saint-Venant's solutions to the relaxed problem of extension, bending, torsion, and flexure of prismatic and cylindrical bodies. The results obtained show that Saint-Venant's solutions for the cases of extension, bending, and torsion are uniquely distinguished—among all solutions to the corresponding relaxed problem meeting certain natural side conditions—by the fact that they render the total strain energy an absolute minimum. In contrast, the classical flexure solution was found to be no longer 'optimal' in the foregoing sense and the determination of the actual optimal flexure solution has been reduced to the solution of a mixed-mixed boundary value problem in elastostatics. Author (TAB)

**N66-14187#** Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

**ELASTIC BUCKLING TESTS ON LATERALLY AND TORSIONALLY BRACED TAPERED I-BEAMS Final Report**

Donald J. Butler Sep. 1965 37 p refs

(Contract NBy-24967)

(TR-2; AD-623595) CFSTI: HC $2.00/MF $0.50

Presented are the results of an experimental investigation which studied the influence of lateral and torsional bracing on the elastic buckling strength of tip loaded, tapered, cantilever I-beams. The principal conclusions may be summarized as follows: A single lateral brace at the free end of the beam should be applied to the top (tension) flange for greatest effect. The most effective combination of end lateral brace and midspan lateral brace consists of an end brace on the top flange and a midspan brace on the bottom flange. Intermediate bracing on the top flange has very little influence on the strength of the beam. Relatively modest torsional bracing effectively inhibits lateral buckling; e.g., a typical roof purlin which might be connected to such members would provide sufficient resistance to twist to achieve full or nearly full torsional bracing. Author (TAB)

**N66-14228#** Southwest Research Inst., San Antonio, Tex.

**LUBRICATION RESEARCH AND TEST METHOD DEVELOPMENT FOR AEROSPACE PROPULSION SYSTEMS Technical Report, 15 Feb. 1964–15 Apr. 1965**

B. B. Baber, W. R. Blackstone, and P. M. Ku Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Aug. 1965 68 p refs

(Contract AF 33(657)-11088)

(AFAPL-TR-65-70; AD-621072) CFSTI: HC $3.00/MF $0.75

This program was concerned with the further development of the ABMA impace tester and the investigation of different test methods used to determine the impact sensitivity of materials in contact with rocket propellants. It was found that the specimen cup material and design had a significant effect on plummet rebound height. The use of a modified anvil region assembly, including a steel specimen cup, significantly increased the reactivity of materials subjected to impace in the presence of LOX in addition to improving plummet rebound height repeatability. The 'up-and-down' test procedure, from which a statistical estimate of the drop height producing a 50-percent probability of reaction may be obtained was investigated. The results of 10 separate up-and-down tests on one grease material showed repeatability to be excellent. Results were also obtained for additional greases and these results showed that some greases rated as satisfactory had about the same 50-percent points as other greases considered unsatisfactory with the only apparent difference being the intensity of the reactions. Author (TAB)

**N66-14240#** General Dynamics/Astronautics, San Diego, Calif. Engineering Dept.

**ACOUSTIC BUFFETING OF A SIMPLY SUPPORTED PANEL**

R. W. Schwarz 30 Dec. 1964 41 p refs

(GD/A-ERR-AN-535)

A theoretical method is presented for the derivation of the exact frequency and response equations for a simply supported panel subject to a random acoustic load. The structure is assumed to act as a multiple degree of freedom system and the acoustic pressure wave is assumed to have a normal incidence. Author

**N66-14241#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**ANALYSIS OF CYLINDRICAL SHELLS UNDER CONCENTRATED EFFECTS**

E. V. Zhikhovich (1965) 7 p refs Transl. into ENGLISH from Prikl. Mekhan. I Tekhn. Fiz. (USSR), v. 1, no. 9, 1965 p 20–25

An approximate method of analyzing cylindrical shells under arbitrary concentrated effects is given. Good convergence of the solution is achieved by performing the analysis of two steps. First the membrane fold is computed and the normal stresses and the angular strains they cause are found. The bending state of the shell as a folded system loaded by the angular strains found in the first stage is then considered. The method permits execution of an analysis of transverse and longitudinal distributed and concentrated forces, as well as the sagging of one or more supports for any boundary conditions on the endplates. Author

**N66-14245*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTRRES. VOLUME I: NUMERICAL METHODS OF SOLVING LARGE MATRICES Final Report**

F. A. Brogan Aug. 1965 33 p refs

(Contract NAS8-11480)

(NASA-CR-68769; M-77-65-5) CFSTI: HC $2.00/MF $0.50 CSCL 20K

This volume presents two basic numerical techniques for solving, by digital computers, large systems of algebraic simultaneous equations resulting from the finite-difference approximation of the partial differential equations of thin elastic shells. Of the methods available for solving such systems of equations, the matrix factorization and two-line successive over-relaxation methods have been discussed extensively. It is found that the direct methods generally require more computer running time than the iterative methods, especially when the size of the matrix is large. However, the former methods permit rapidly varying mesh spacing which is desirable for the accurate determination of the boundary-layer behavior of fixed-edge shell elements involved in multicellular pressure vessels. Author

**N66-14274#** Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.

**EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ELASTICITY ON THE STABILITY OF MANNED ROTATING SPACE STATIONS**

Jacob M. Miller and Frank J. Frueh Jun. 1965 32 p refs

(Contract AF 49(638)-1015)

(ATOSR-65-1404; AD-620866) CFSTI: HC $2.00/MF $0.50

The report presents the results and conclusions obtained from an experimental program investigating the structural dynamic stability of an elastic model of a manned rotating space station. Stability criteria for this aerospace configuration were theoretically derived and model tests were performed to substantiate these stability criteria and to demonstrate that an elastic instability of such configurations is possible. Author (TAB)

**N66-14287*#** Minnesota Univ., Minneapolis.
**KINETIC CONSIDERATIONS OF THE STRENGTH OF ORIENTED SOLIDS**
C. C. Hsiao, H. H. Kausch Von Schmeling, and C. S. Ting Sep. 1965 9 p refs
(Grant NGR-24-005-070; Contract AT(11-1)-532)
(NASA-CR-68970; TR-102) CFSTI: HC $1.00/MF $0.50
CSCL 20K

The mechanical strength of an oriented and stressed solid is considered on the basis of using the statistical absolute reaction rate theory. It is shown that for large applied stresses the fracture strength is almost linearly related with logarithm of time. For small stresses the time-to-break required approaches to infinity. Author

# 33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

**N66-13365#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**HEAT PHYSICS AND HEAT ENGINEERING Selected Articles**
22 Jul. 1965 39 p refs Transl. into ENGLISH from the publ. "Teplofizika i Teplolekhnica" Kiev, Akad Nauk Ukr. SSR, Inst. Tekhn. Teplofiz., 1964 p 154–176, 202–206, 215–222
(FTD-MT-65-73; AD-619477) CFSTI: HC $2.00/MF $0.50

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3. BURNING OF A DROP IN A FLOW OF AIR L. P. Latonina, V. A. Fedoseyev, and D. I. Polishchuk p 10–13 refs (See N66-13368 04-33)
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**N66-13366** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**GENERAL PRINCIPLES OF COMBUSTION OF DROPS OF SUSPENSIONS**
D. I. Polishchuk, L. P. Latonina, and V. L. Velikano Va-Yankevich *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 1–6 refs (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

Experiments were conducted on the combustion of suspended drops of aluminum, magnesium, and boron in kerosene, gasoline, isooctane, and alcohol in a flow of heated air to clarify the physical picture of combustion. The burning time of the drops was measured and found to vary with composition, temperature, flow rate, and dimension. Burning of suspensions in petroleum products was found to occur in stages. As temperature was increased the stages combined so that the suspensions burned as a whole. Flow rate had a definite effect on burning rate of the suspension, however, as temperature increased, the influence of flow velocity decreased and above 800° C flow velocity had virtually no effect on burning rate. Suspensions in isooctane burned the slowest. Suspensions in petroleum products burned almost identically. Suspensions in alcohol burned the most rapidly. R.N.A.

**N66-13367** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**KINETICS OF COMBUSTION OF A DISPERSED METALLIC FUEL**
V. A. Fedoseyev *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 7–9 (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

The combustion kinetics of dispersed metallic particles were investigated. Flame tracks were observed to prove that different solid fuels dispersed as powders have different burning characteristics. Particle shape had a definite effect on the processes of ignition and combustion. In the pre-flame, spherical particles develop an oxide coating. Upon ignition, the oxide coat collapses and flame envelopes the entire sphere. Elongated particles ignite at their sharp ends, the sharper the end the more easily the particle ignites. From the ignition point, the flame spreads over the whole particle. This type of ignition and combustion is also characteristic of fuels in the form of rods, spirals, and platelets. R.N.A.

**N66-13368** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**BURNING OF A DROP IN A FLOW OF AIR**
L. P. Latonina, V. A. Fedoseyev, and D. I. Polishchuk *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 10–13 refs (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

The kinetics of burning drops of fuels and other combustible liquids were investigated. The temperature of the burning drops, of the flame, and of other combustion characteristics was measured. The influence of air flow speed on the burning process was also studied. It was determined that at certain flow velocities, the flame is blown off from the drop and burning occurs only behind the drop. The flow speed necessary for flame separation was found to depend on the drop diameter at temperatures in the range 25° to 1000° C. The drops were suspended on special suspension devices and photographed through a microscope with the help of a movie camera. The results of flame separation speed measurements for drops of B-70 gasoline, T-1 fuels, and isooctane are discussed. R.N.A.

**N66-13369** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATION OF A TURBULENT FLAME BY THE METHOD OF SCHLIEREN PHOTOGRAPHY**
G. A. Mokhov *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 14–17 (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

Changes in the turbulent characteristics of a heterogeneous flame during velocity changes of the external annular air flow were determined by Schlieren photography. The turbulent characteristics investigated were average flow rate, root mean square pulsation velocity along the axis of flow, Euler and Lagrange scales of turbulences, degree of turbulence, and coefficient of turbulent exchange. The qualitative results obtained were satisfactory and are discussed. R.N.A.

**N66-13370** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**COMBUSTION MODELING AS A METHOD OF INVESTIGATION OF AERODYNAMIC PROCESSES DURING COMBUSTION**
P. I. Lavrov *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 18–24 (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

The method of approximate modeling of combustion processes to investigate the aerodynamic processes occurring during combustion is discussed. The combustion modeling method was found to be a satisfactory means of investigating aerodynamic processes during combustion. During modeling of the combustion processes, photometric methods of investigation were very effective. The method of combustion modeling of thermophysical phenomena during combustion is promising, but needs further development in theory as well as in modeling techniques. R.N.A.

**N66-13371** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CERTAIN PRINCIPLES OF DEVELOPMENT OF DIFFUSION GAS FLAME BURNING IN THE TURBULENT WAKE BEHIND A STABILIZER**
V. A. Khristich and G. N. Lyubchik *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 25–29 refs (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

Principles involved in diffusion gas flame burning in the turbulent wake behind a stabilizer are discussed. R.N.A.

**N66-13372** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CONCERNING THE QUESTION OF THE NATURE OF VIBRATIONS COMBUSTION IN HIGHLY FORCED COMBUSTION DEVICES OPERATING ON GASEOUS FUEL**
V. A. Kristich and Yu. N. Bashkatov *In its* Heat Phys. and Heat Eng. 22 Jul. 1965 p 30–36 refs (See N66-13365 04-33) CFSTI: HC $2.00/MF $0.50

The role of acoustic factors in vibrational combustion observed in gas turbine combustion chambers was investigated. The influence of combustion chamber length, design of gas burning devices, excess air coefficient in the combustion zone, and air flow speed on the combustion regime were examined. It was shown that at the basis of vibrational combustion during combustion of gases in gas turbine combustion chambers and highly forced combustion devices similar to them, there lie acoustic vibrations of the hot gas column which are supported by heat emission in the combustion chamber which changes in rhythm with these oscillations. It was not possible to determine the main mechanism of feedback between acoustic vibrations and heat release in such furnaces. R.N.A.

**N66-13373*#** National Bureau of Standards, Washington, D. C.
**A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Fifth Preliminary Report, 1 Jul.–30 Sep. 1965**
Mary K. Buresh, Martin L. Reilly, George T. Furukawa, and George T. Armstrong 1 Oct. 1965 30 p refs
(NASA Order R-138)
(NASA-CR-68618; NBS-8992) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The analysis of low temperature heat capacity data on CHNOPS compounds is continuing. A systematic compilation of a bibliography on heat capacity data of ammonia, carbon dioxide, and water is being made. A tabulated list of literature data examined to date for this bibliography is included. R.N.A.

**N66-13435#** Pratt and Whitney Aircraft, Middletown, Conn.
**SOLUBILITY OF REFRACTORY METALS IN LITHIUM AND POTASSIUM**
R. E. Cleary, S. S. Blecherman, and J. E. Corliss 27 Oct. 1965 62 p refs
(Contract AT(30-1)-2789)
(TIM-850)

The solubilities of molybdenum and niobium were determined in lithium to 1320° C and in potassium to /205° C. The effects of oxygen, nitrogen, and carbon additions to the solvent were investigated. The solubility of molybdenum in purified lithium and potassium is less than 1.0 ppm. Additions of oxygen and nitrogen to lithium had no effect on the solubility of molybdenum. Additions of oxygen to potassium (as $KO_2$, $K_2CO_3$, or $KNO_3$) increased the apparent solubility of molybdenum in potassium. A crystalline product was isolated from the K–O–Mo system and identified as $K_2MoO_4$. The solubility of niobium in purified lithium can be expressed by the equation $\log_{10}S$ (atom percent Nb) = 4.77 − 1094/T° K. The solubility results were correlated with engineering loop results indicating that niobium and molybdenum base alloys should be acceptable for application in high temperature high purity liquid metal systems. R.N.A.

**N66-13437#** Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
**DEVELOPMENT OF AN OLIVE DRAB SOLAR HEAT REFLECTING AND LOW VISIBILITY ENAMEL Final Report**
Melvin H. Sandler 4 Oct. 1965 32 p refs
(CCL-188; AD-473571)

This report covers the development of an olive drab solar heat reflectant and low visibility enamel for use on missiles and related ground support equipment such as instrument trailers and vans. This enamel, provides higher solar heat reflectance than any other dark shade enamels, is relatively inexpensive in cost and is olive drab color. Author (TAB)

**N66-13438#** ARO, Inc., Arnold Air Force Station, Tenn. Von Kármán Gas Dynamics Facility.
**THEORETICAL AND EXPERIMENTAL STUDIES OF HYPERSONIC VISCOUS EFFECTS**
Clark H. Lewis and Jack D. Whitfield Arnold Eng. Develop. Center, May 1965 58 p refs Presented at the AGARD Specialist's Meeting on Recent Develop. in Boundary Layer Res., Naples, 10–14 May 1965
(Contract AF 40(600)-1000)
(AEDC-TR-65-100; AGARDOGRAPH-97, Pt. III; AD-462717)

The effects of viscous interaction and transverse curvature on the heat-transfer and pressure distributions and zero-lift drag are presented for a 9-deg spherically blunted cone with a nose-to-base radius ratio of 0.3 at M = 9 and 18 over a range of Reynolds numbers. The effects of viscous interaction are obtained by iterating the viscous (boundary layer) and the inviscid (characteristics) flow fields. Comparisons are given with available experimental data which, in general, show good agreement with the predicted pressure distributions. The experimental heat-transfer data are in good agreement with the predictions including viscous interaction but without transverse curvature. Including transverse curvature overestimates the heat-transfer rate about 15 percent. The predicted drag is approximately 17 percent below the mean of the experimental drag data. An experimental shock layer pitot profile is compared with boundary-layer and characteristics solutions at one location on the cone at M = 18. The effects of shock-generated external vorticity are neglected in the present study; however, the effects on the pitot profile data are discussed. Author (TAB)

**N66-13459#** Aberdeen Proving Ground, Md. Ballistic Research Labs.

**VAPORIZATION WAVES AS A GENERAL PROPERTY OF HIGH TEMPERATURE MATTER**

F. D. Bennett Jan. 1965 13 p refs

(BRL-R-1272; AD-463128)

Electrical data on exploding wires suggest strongly that vaporization waves can occur in all metals. If a vapor pressure function capable of representing that data for metals is assumed, the thermodynamic, vaporization wave velocity can be expressed in terms of a general function and a characteristic velocity. Values of this velocity have been calculated for several metals and show a spread of 4 orders of magnitude. Necessary conditions are proposed under which any substance can exhibit vaporization waves at high temperatures. Author

**N66-13468#** Falcon Research and Development Co., Denver, Colo.

**EXPLOSIVE SOURCES FOR MAGNETOHYDRODYNAMIC ENERGY CONVERSION Final Report, Jun. 1963–Oct. 1964**

Marvin W. Burnham Sep. 1965 91 p refs

(Contract AF 08(635)-3818)

(ATL-TR-65-14; AD-472841)

Elementary concepts of detonation theory are discussed primarily in the classical context. An illustration of the essential non-linearity of the equations is given. Several assumptions utilized in current theories are discussed and experiments designed to evaluate the validity of these are described. All discussion is from a continuum point of view. Information related to the use of explosives as energy sources for magnetohydrodynamic energy conversion is given. Instrumentation used in the experiments is discussed. Author (TAB)

**N66-13472#** Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.

**ABLATION OF EXTREME-TEMPERATURE-RESISTING MATERIALS IN ROCKET EXHAUSTS**

Joe M. Viles 9 Nov. 1965 62 p

(Contract DA-01-021-AMC-11660(Z))

(S-81; AD-473835)

The ablation rate of contoured Micarta (laminated plastics) specimens immersed in solid propellant exhaust gases was measured under closely controlled conditions. The effect of particles in the exhaust stream was demonstrated by carrying out firings with propellants containing 0.5%, 8%, and 16% aluminum. Firings at chamber pressures of 400 psia and 550 psia showed the effect of pressure on ablation rate. The ablation rate increased directly with chamber pressure and aluminum content of the propellant. Raw data for heating rate calculations were obtained for each propellant from instrumented copper calorimeters and heat flux transducers. Author (TAB)

**N66-13522#** International Union of Pure and Applied Chemistry, Basle (Switzerland).

**BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, JULY, AUGUST, SEPTEMBER, VOLUME 1965, NUMBER 3**

J. J. Diamond, ed. (Natl. Bur. Standards) [1965] 107 p refs

CFSTI: HC $4.00/MF $0.75

A bibliography is presented on the high temperature chemistry and physics of materials in the condensed state. References are included on devices for achieving temperatures above 1500° C; devices for measuring and controlling temperatures above 1500° C; devices for physical measurements at temperatures above 1000° C; properties at temperatures below 1000° C of metallic, nonmetallic, and mixed materials which melt above 1500° C; properties at temperatures above 1000° C of metallic, nonmetallic, and mixed materials which melt above 1500° C; properties at temperatures above 1000° C of metallic and nonmetallic materials which melt below 1500° C; phase equilibria; and reactions at temperatures above 1000° C. R.N.A.

**N66-13529#** Institut Franco-Allemand de Recherches, St. Louis (France).

**STUDIES OF THE CHEMICAL REACTIONS PRODUCED BY DETONATION AT HIGH VELOCITY IN GAS OR MIXTURES OF GASEOUS REAGENTS [UNTERSUCHUNG CHEMISCHER REAKTIONEN BEI EINSCHUSS IN REAGIERENDE GASE ODER GASGEMISCHE MIT HOHEN GESCHWINDIGKEITEN]**

W. Struth, H. Behrens, and F. Wecken 21 Jun. 1963 56 p refs In GERMAN

(ISL-T-9/63) CFSTI: HC $3.00/MF $0.50

The high velocity injection of small projectiles into gases and gaseous mixtures and the resultant explosive shock wave formations were studied by shadow or schlieren photography. Projectile velocities above 1950 m/s in an $H_2$ and air mixture formed an even combustion front behind the shock wave; diminishing velocities introduced periodic wave instabilities with gas detonations. Projectiles entering various endothermic gases formed different uneven shock wave structures, probably due to chemically induced turbulences. Transl. by G.G.

**N66-13534#** Institut Franco-Allemand de Recherches, St. Louis (France).

**MEASUREMENT OF THE VELOCITY OF DETONATION OF A MIXTURE OF ACETYLENE AND OXYGEN WITH THE HELP OF MICROWAVES [MESSUNG DER DETONATIONGESCHWINDIGKEIT VON AZETYLEN-SAUERSTOFF-GEMISCHEN MITHILFE V]**

B. Koch, H. Freiwald, and H. W. Koch 18 Jul. 1963 16 p refs In GERMAN

(ISL-T-17/63) CFSTI: HC $1.00/MF $0.50

Measurements of microwave reflections from the ionized detonation front of two acetylene-oxygen mixtures in a tunnel are described. Developing Doppler signals were used to determine the detonation velocities as well as the lower limit of

the electron concentration in the front. It was concluded that the detonation front is characterized by a certain increase in ionized particles, and that this phenomenon can be utilized for high accuracy measurements. Transl. by G.G.

**N66-13585#** Linde Div., Union Carbide Corp., Indianapolis, Ind.
**PERFORMANCE IMPROVEMENT OF ARC HEATERS FOR AERODYNAMIC WIND TUNNELS Final Report, 15 Apr. 1964–14 Jun. 1965**
Richard C. Eschenbach, James R. Mc Leod, Edward F. Stresino et al Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1965 89 p refs
(Contract AF 33(615)-1749)
(AFFDL-TR-65-87; AD-623387) CFSTI: HC $3.00/MF $0.75

Three avenues for increasing the enthalpy attainable from scalable high performance arc heaters were studied: radiation loss reduction, magnetic control of arc terminations and geometry changes. The radiation loss work showed centerline arc column enthalpies over 30,000 Btu/lb. Because the arc column is optically thin, substantial reduction of radiation loss seems infeasible. Large arc devices will be limited more by radiation than small. Modest improvements in performance were achieved with magnetic interactions, which were found to be extremely complex. Proper proportioning of radial and axial field components was quite important, especially in maintaining scalability. Marked undesirable effects occurred when the auxiliary field coil was located near the electrode gap. Distinct performance improvements were achieved by changes in geometry, with air injection and chamber design the most significant for the low flow, high current region studied. Author (TAB)

**N66-13634*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**AEROTHERMOCHEMICAL ANALYSIS OF NON-OSCILLATORY AND OSCILLATORY CHARACTERISTICS OF LIQUID BIPROPELLANT ROCKET MOTORS: DROPLET EVAPORATION, WAVE EQUATIONS, MOTOR INSTRUMENTATION, NON-OSCILLATORY PROGRAM COMPUTATION**
Vito D. Agosta and S. Z. Burstein 15 Apr. 1965 53 p refs *Its* Rept.-65-2
(Contract NAS7-100)
(NASA-CR-68576) CFSTI: HC $3.00/MF $0.50 CSCL 20I

A model is presented for the determination of the vaporization rate of a liquid fuel droplet. The governing equation is the heat conduction equation with the appropriate boundary and initial conditions, which include an energy balance at the surface of the droplet. An approximate solution to this problem is found utilizing a heat balance integral and an assumed temperature distribution. Transient and steady-state solutions are thereby obtained and applied to a particular combustion problem. The solution is compared to a diffusion limited analysis and is found to be in agreement. Finally, the method is used to determine the additional mass release which is due to the passage of a longitudinal wave over the evaporation droplet.
Author

**N66-13642*#** California Univ., Berkeley. Space Sciences Lab.
**GENERATION OF FLOW FIELDS IN PARTICLE FUELED COMBUSTION SYSTEMS Technical Note No. 1**
C. W. Busch May 1965 105 p refs *Its* Ser. 6, Issue 17
(Grant NsG-702)
(NASA-CR-68478) CFSTI: HC $4.00/MF $0.75 CSCL 21I

The study is concerned with the dynamic properties of an explosion in a medium consisting of condensed phase fuel particles dispersed in a gaseous oxidizer. The influence of the parameters which characterize the problem is determined from numerical solutions of a simplified analytical model and the effect of transport phenomena on equilibrium gas-particle dynamics is examined. At first two extremes of particle motion in the compression wave are taken into account: (I) when they are assumed to be stationary at all times; (II) when they are supposed to follow the gas motion identically. Then the effects of a more realistic particle motion are investigated. The solutions, obtained by the use of an IBM 7090 computer, refer to the properties of a hydrazine spray in oxygen initially at NTP, and use the initial loading factor (ratio of particle to gas concentrations) and the relative combustion front velocity as the major parameters of the problem. Author

**N66-13705#** Brookhaven National Lab., Upton, N. Y.
**HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, A BIMONTHLY TECHNICAL PROGRESS REVIEW, VOLUME 3, NUMBER 4**
O. E. Dwyer, ed. Nov. 1965 54 p refs Sponsored by AEC
(BNL-953(PR-16)) CFSTI: $3.00

Current topical and progress reports on various research and development programs in high temperature liquid metal technology are reviewed. Phases covered include materials development, corrosion and mass transfer, heat transfer, fluid dynamics, instrumentation, purification, component development, physical properties, thermodynamics, chemical analysis, and power systems. M.G.J.

**N66-13708#** Iowa State Univ. of Science and Technology, Ames. Ames Lab.
**APPLICATION OF GIBBS–DUHEM EQUATION TO BINARY VAPOR–LIQUID EQUILIBRIUM DATA OF METAL SYSTEMS USING NEWTON'S INTERPOLATION FORMULAE**
V. E. Sater and F. D. Stevenson Aug. 1965 35 p refs
(Contract W-7405-ENG-82)
(IS-1241) CFSTI: $2.00

Integration of the Gibbs-Duhem equation using Newton's interpolation formulae has been programmed in Fortran for both smoothed and unsmoothed activity coefficient data of binary systems, giving values of the second activity coefficient as a function of concentration. The conventional area test has also been programmed to test the thermodynamic consistency when both activity coefficients have been independently determined. The Gibbs-Duhem equation is additionally used with numerically differentiated values of the log activity coefficient-concentration curves to indicate local consistency of the data. The programs and examples of their application are included.
Author

**N66-13712#** Woods Hole Oceanographic Institution, Mass.
**STEADY AND OSCILLATORY MOTIONS OF A DIFFERENTIALLY HEATED FLUID LOOP**
Pierre Welander Sep. 1965 36 p
(Contract Nonr-2196(00))
(Rept.-65-48; AD-621368) CFSTI: HC $2.00/MF $0.50

A theoretical study is made of the motion of a closed fluid tube heated from below and cooled from above. It is found that the steady convective motion, in which warm fluid rises in one branch and cold fluid sinks in the other branch of the tube, may become unstable and growing pulsations occur in the system. The result has been obtained by a stability analysis and also verified by direct numerical time integrations on the computer GE 225. Author (TAB)

**N66-13727#** Watervliet Arsenal, N. Y. Benet Labs.
**THE HEATING OF METALS IN AN ELECTROLYTE**
Herbert Frankel Sep. 1965 22 p refs
(WVT-6528; AD-623019) CFSTI: HC $2.00/MF $0.50

Steel can be heat treated electrically while submerged in an electrolyte. The advantages of this process are: (1) rapid heating, (2) prevention of scale by the automatic generation of hydrogen which surrounds the work, (3) automatic quench in the same tank when the current is interrupted. On small samples, heating rates as high as 350° F per second and as low as 6.6° F per second have been achieved with the likelihood of being able to increase substantially the rate with higher voltage. In a 10% solution of sodium carbonate, which is inexpensive and can be used indefinitely, current densities of 21 to 27 amperes per square inch at 200 volts were recorded during heating. Disadvantages of the process include: (1) a large D. C. generator is required for moderately large pieces, (2) the process is less than 12% efficient, (3) protected thermocouples must be attached to the work, (4) although not required for small samples, an exhaust system would be required to remove the liberated hydrogen when heating large pieces, (5) temperatures induced are not uniform throughout the specimen. Author (TAB)

**N66-13730#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**FUNDAMENTAL SOLUTION FOR APPROXIMATE EQUATIONS OF THE STATIONARY PROBLEM OF THE THERMAL CONDUCTIVITY OF MILDLY SLOPING DIAPHRAGMS**
S. Ya. Yarema 8 Oct. 1965 10 p refs Transl. into ENGLISH from Vopr. Mekhan. Real'nogo Tuerd. Tela, Akad. Nauk Ukr. SSR, Inst. Mashinoved. i Avtomatiki (Kiev), no. 3, 1964 p 88–94
(FTD-TT-65-1140/1+4; AD-622358) CFSTI: HC $1.00/MF $0.50

The equations of thermal conductivity for mildly sloping diaphragms are examined under limiting conditions of the third type. The fundamental solution to the equations is obtained by the method of integral transformations. Author (TAB)

**N66-13731#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THE FUSION OF A METAL BODY IN THE VICINITY OF CRITICAL POINT**
B. I. Reznikov 17 Sep. 1965 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 8, no. 1, 1965 p 93–97
(FTD-TT-65-866/1+4; AD-622359) CFSTI: HC $1.00/MF $0.50

An approximate analytical solution to the problem of ablation of a metal body near the stagnation point is considered. It is shown that the problem solution is reduced to integration of a non-linear boundary-value problem of the third order with supplementary condition for determination of the unknown thickness of the film. The precise solution of the boundary-value problem of interest is fairly approximated by the first terms of the Taylor series of the desired function near the zero point. This is confirmed by estimation of the residual term and by comparison with computed values. For fused metals the expression of the rate of ablation is found in a finite form to within 3–5% and may be approximated by the power dependence of the Mach number. The results of the steady-state theory are used for determination of ablation value when a body flies with a variable velocity and at a constant altitude. The dependence of ablation on pressure is found which corresponds to maximum ablation. Author (TAB)

**N66-13750#** American Meteorological Society, Boston, Mass.
**EXPERIMENTAL DETERMINATION OF THE ENTHALPY, TEMPERATURE, AND HEAT OF PHASE TRANSITION OF THE $\alpha$-MODIFICATION OF $Al_2O_3$ IN THE TEMPERATURE RANGE 1200° TO 2500° K [EKSPERYMENTAL'NE VYZNACHENNIA ENTAL'PYI, TEMPERATURY I TEPLOTY FAZOVOGO PEREKHODU]**
P. B. Kantor, L. S. Lazariev, V. V. Kandiba, and Ie. M. Fomichov Bedford, Mass., AFCRL, Sep. 1965 12 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 7, no. 2, 1962 p 205–211
(Contract AF 19(628)-3880)
(T-U-2; AD-621423) CFSTI: HC $1.00/MF $0.50

An investigation was made of the enthalpy of the alpha-modification of $Al_2O_3$ (corundum) at high temperatures with a view toward using it as a heat-capacity 'standard' for high-temperature calorimeter research. Corundum may be obtained in pure form, has high chemical and thermal stability, and a high specific heat. Corundum has several crystal-line modifications, of which the alpha-modification is the most widely distributed natural form, and may be produced synthetically. An investigation was made of samples of colorless corundum, consisting of crystals 30 mm long and 2 mm in diameter, and of 99.99% purity. Molybdenum capsules were employed in the experiments. It was shown that no reactions occur in the system Mo-$Al_2O_3$ at temperatures up to 2000° K. It was also found (within experimental accuracy) that no reaction occurred in the hermetically sealed molybdenum capsules during measurements of the enthalpy of liquid corundum. TAB

**N66-13795#** Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**ABSORPTION COEFFICIENTS OF HEATED AIR: A COMPILATION TO 24 000° K, VOLUME I Final Report, 1 Apr. 1964–30 Jul. 1965**
D. R. Churchill, B. H. Armstrong, and K. G. Mueller Oct. 1965 113 p refs
(Contract AF 29(601)-6320)
(LMSC-4-77-65-1; AFWL-TR-65-132, Vol. I; AD-622797) CFSTI: HC $4.00/MF $0.75

An extensive tabulation of absorption coefficients of heated air has been carried out with the aid of several large digital computer programs. These tables supersede the previous ones computed at Lockheed by Meyerott, Sokoloff, and Nicholls in 1959. Tables are presented for temperatures at every 1000° K between 1000° K and 24,000° K and for eight densities between ten times normal atmospheric to 0.000001 times normal. Absorption coefficients are individually listed for each of 14 contributing absorbers. The photon energy range is 0.6–10.7 eV with a partition interval of 0.1 eV. Author (TAB)

**N66-13809#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**COOLING THE MOVING BLADES OF GAS TURBINES WITH A LIQUID-METAL HEAT-TRANSFER AGENT**
L. I. Slobodyanyuk and V. A. Omelyuk 12 Oct. 1965 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), v. 3, 1965 p 61–66
(FTD-TT-65-1370/1+2+4; AD-622466) CFSTI: HC $1.00/MF $0.50

Evaporative cooling assures high efficiency and less complexity of the working blades, as compared with air cooling. At the same time, with evaporative cooling it is necessary to replenish the water by means of a special distillation apparatus. TAB

**N66-13827*#** United Aircraft Corp., East Hartford, Conn.
**EXPERIMENTAL REFRACTIVE INDICES AND THEORETICAL SMALL-PARTICLE SPECTRAL PROPERTIES OF SELECTED METALS**
P. J. Marteney, N. L. Krascella, and W. G. Burwell Sep. 1965 67 p refs
(Contract NASw-847)
(NASA-CR-68865; D-910092-6) CFSTI: HC $3.00/MF $0.75 CSCL 20M

An applied research program was conducted to determine the absorption, scattering, and extinction parameters of small spherical metal particles which might be employed as seeding agents to control radiant heat transfer in gaseous nuclear rocket engines. Under the experimental phase of the program, measurements were made using an ellipsometric technique to determine the complex refractive indices of hafnium, molybdenum, nickel, and tungsten in the wavelength range between 0.2 and 0.7 microns. Under the theoretical phase of the program calculations were made using the Mie theory to determine spectral absorption, scattering, and extinction parameters of small spherical particles made from nine different metals. These calculations were made using values of the complex refractive indices of the four metals investigated in the experimental phase of the program and the complex refractive indices for cobalt, iron, titanium, vanadium, and zirconium determined from the current literature. Calculations were also made of the Rosseland mean opacity parameter of 0.05μ-radius tungsten particles using spectral absorption parameters determined from the Mie theory.
Author

**N66-13834*#** General Electric Co., Philadelphia, Pa.
**COATING SELECTION PROGRAM, PART I: THEORY**
Frederick Costello et al 15 Apr. 1965 48 p refs *Its* Doc.-65SD526
(Contract NASw-960)
(NASA-CR-68850) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A rational and direct method was developed for selecting the optical coating pattern for the external surface of a spacecraft, such that the spacecraft temperatures are as close as possible to the midpoint of their preselected ranges. The temperature control is maintained passively by radiation and conduction, using no active control devices. The complete range in mission environments is considered in the optimization procedure. The selection technique has been programmed for use on the GE 600 series, IBM 7094, or any other computer that uses the standard IBM Fortran IV system.
Author

**N66-13849*#** Lockheed-Georgia Co., Marietta.
**AN EXPERIMENTAL INVESTIGATION OF INTERNAL RESISTANCE SHOCK TUBE DRIVER GAS HEATING SYSTEMS Final Report**
R. F. Sturgeon and D. E. Alford 26 Apr. 1965 137 p refs
(Contract NAS8-11349)
(NASA-CR-68771; ER-7823) CFSTI: HC $4.00/MF $1.00 CSCL 13A

An experimental investigation of internal resistance shock tube driver gas heating systems was conducted, utilizing a heating system designed and implemented for use with a 3-foot shock tunnel. The heating system was designed to satisfy operational requirements defined by a helium driver gas temperature of 1000° F at 15,000 psia. Included in the experimental program were decompression tests of thermal insulating materials, measurements of the effects of internally mounted structures on shock tube performance, and investigations of heat transfer processes in internal resistance heating systems. The experimental results were applied to a hypersonic shock tunnel.
Author

**N66-13864#** Atomic Energy Establishment, Winfrith (England). Reactor Group.
**AN EXPERIMENTAL COMPARISON BETWEEN FORCED CONVECTION BURN-OUT IN FREON 12 FLOWING VERTICALLY UPWARDS THROUGH UNIFORMLY AND NON-UNIFORMLY HEATED ROUND TUBES**
G. F. Stevens, D. F. Elliott, and R. W. Wood May 1965 19 p refs Submitted for Publication
(AEEW-R-426) CFSTI: HC $1.00/MF $0.50

Some correlations of forced convection burn-out data are based on the approximate linearity of the relationship between burn-out heat flux and the channel-averaged quality at the burn-out point. These correlations perform satisfactorily on data obtained from uniformly heated configurations. Therefore the further inference is sometimes made that the burn-out heat flux is uniquely related to the quality, and that the burn-out in non-uniformly heated configurations can be calculated from measurements made with uniform heating. This report presents burn-out data for Freon 12 flowing vertically upwards through both uniformly and non-uniformly heated round tubes. These data show that the quality at burn-out does depend on the heat flux profile, and that the inference mentioned above is not justified.
Author (NSA)

**N66-13877#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SOLVING OF ONE MIXED PROBLEM OF THERMAL RADIATION FIELD THEORY**
Yu. A. Surinov 14 Sep. 1965 26 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 2, 1959 p 78–91
(FTD-TT-65-1261/1+4; AD-621783) CFSTI: HC $2.00/MF $0.50

Given is a solution of a mixed problem concerning radiant heat exchange in a radiation system of arbitrary configuration, consisting of gray bodies, divided by a diathermal medium. It was shown, the solution of the given problem, characterized by mixed fixing of boundary conditions, is reduced to solving the fundamental set-up of the problem. The obtained results allow to generalize methods of the light field theory and serve as basis for the formulation of scientifically based methods of calculating radiant heat exchange in various technical devices, for example in high temperature electro furnaces, etc. From the derived results in role of special cases can be found all known formulas for the calculation of radiant heat exchange in systems of gray bodies, used in thermo-physics, thermo-engineering, illumination technology and heliotechnology.
Author (TAB)

**N66-13894#** Utah Univ., Salt Lake City. Inst. for the Study of Rate Processes.
**KINETICS AND THERMODYNAMICS OF COMBUSTION Final Report**
George Richard Hill, Henry Eyring, and Carl J. Christensen 30 Sep. 1956 19 p refs
(Contract AF 33(038)-20839)
(AFOSR-TR-56-52; AD-620895) CFSTI: HC $2.00/MF $0.50

Contents: The experimental determination of free radical mechanisms in gas phase aldehyde oxidations. The thermal decomposition of hydrocarbons and related compounds. The kinetics of oxidation of carbon films. Kinetics of combustion

of methylamine. Infra-red kinetic studies of diborane. The pyrolysis and polymerization mechanisms of large organic molecules. TAB

**N66-13928#** Lockheed Missiles and Space Co., Sunnyvale, Calif.

**ON STEADY-STATE ABLATION SHAPES OF SOLIDS AROUND WHICH A TWO-DIMENSIONAL IDEAL FLUID FLOWS**

V. A. Maksimov [1965] 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhan. Nauk: Mekhan. (Moscow), no. 5, 1965 p 7–10

Steady state shapes of body boundaries are found for ablation when a plane-parallel ideal fluid flows around a semi-infinite body. Assumptions are that the body is streamlined by an irrotational, ideal incompressible fluid flow; that molecular heat transfer or diffusion along the streamlines of the fluid may be neglected; and that the heat flux within the body may be neglected in thermal problems, as compared with the heat flux from the fluid to the body boundary which is required for ablation. Using the concepts of complex variables, an expression is obtained for the ablation rate; showing that under identical external conditions a one parameter family of semi-infinite bodies exists which retains its shape during ablation. Some examples are included showing the orders of the velocities obtained for various ablation processes by using this derived equation. C.T.C.

**N66-13963#** California Univ., Berkeley. Space Sciences Lab.

**THE CONDENSATION OF STEAM AT LOW PRESSURES**

A. F. Mills 23 Nov. 1965 170 p refs *Its* Ser. No. 6, Issue No. 39

(Grant NSF GP-2520)

The film condensation of water on a vertical flat plate under vacuum conditions was investigated. The interfacial resistance to heat transfer was measured and the result was used to deduce the value of the condensation coefficient of water. No significant interfacial resistance was observed and a value of unity was indicated for the condensation coefficient of water. Water and alcohols both form hydrogen bonds in the liquid phase and as a result theory predicts low values of condensation coefficients for both. Previous experimental results with methyl, ethyl, and n-propyl alcohols apparently confirm these predictions. However, preliminary tests on n-butyl alcohol have shown no evidence of an interfacial heat transfer resistance and hence the condensation coefficient for n-butyl alcohol is close to unity. E.E.B.

**N66-14024#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**INVESTIGATION OF ACCELERATING THE CONVERGENCE OF AN IMPLICIT NUMERICAL SOLUTION OF TRANSIENT HEAT TRANSFER PROBLEMS**

George Francis Cudahy (M.S. Thesis) Aug. 1965 81 p refs (GA/PH/65-4; AD-621273) CFSTI: HC $3.00/MF $0.75

This study investigates two methods of increasing the rate of convergence of the two dimensional five point implicit finite difference representation of the diffusion equation of transient heat transfer. The two methods are adapted Wegstein and successive overrelaxation. Various techniques of scanning the mesh system formed by the finite differences and an 'a priori' overrelaxation factor are also investigated. An example problem is used to determine that successive overrelaxation with a sophisticated technique of repeatedly scanning all boundary values of the problem into the finite difference mesh is the fastest system of those tested to solve the implicit simultaneous equations of this study. The solutions of twenty-eight (28) other problems by this same system show that an average of 35.2% savings in number of iterations to solution is realized by this system as compared to successive overrelaxation with a conventional repetitive scanning technique. An 'a priori' relaxation factor which is related to the maximum temperature gradients of the problem is obtained. This 'a priori' factor is within 10% of the optimum relaxation factors for all problems and is an accurate approximation for those problems without heat generation. Author (TAB)

**N66-14025#** Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering.

**UNCONVENTIONAL METHODS FOR INFLUENCEING FLUID FLOW. PART III: THERMAL PUMPING Final Report, Oct. 1963–Apr. 1965**

Jon G. Mc Gowan (Ph.D. Thesis) Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jul. 1965 142 p refs

(Contract AF 33(657)-9914)

(AFAPL-TR-64-133, Pt. III; AD-621720) CFSTI: HC $4.00/MF $1.00

Thermal pumping, defined as the conversion of thermal energy (heat) into mechanical pumping energy (flow work) in a device without any moving parts, is examined in detail for four major types of devices. These unconventional pumping devices used the physical effects of capillarity, thermocapillarity, osmosis, or thermo-osmosis to influence the fluid flow through a particular convertor. Each convertor is analyzed using steady-state thermodynamic considerations that restrict the operation of the device to small deviations from equilibrium conditions. This initial analysis enables such performance characteristics as maximum thermal efficiency, optimum flow rates, and maximum pressure rises to be analytically and numerically evaluated for each convertor. For the case of the capillary and osmotic pumping devices the initial performance analysis was extended to allow for arbitrarily large pressure rises through these pumping devices. On the basis of this expanded analysis, a complete numerical study yielded sets of performance curves showing the effect of varying system parameters on the performance of either device. Author (TAB)

**N66-14090#** Centre National de La Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.

**STUDY OF THE TEMPERATURE DISTRIBUTION BETWEEN TWO COAXIAL CYLINDERS IN A RAREFIED ATMOSPHERE AT REST AND FLOWING [ETUDE DE LA DISTRIBUTION DES TEMPERATURES ENTRE DEUX CYLINDRES COAXIAUX DANS UNE ATMOSPHERE RAREFIEE AU REPOS OU EN ECOULEMENT]**

Daniel Malegue Oct. 1965 40 p refs In FRENCH

(Rept.-65-7) CFSTI: HC $2.00/MF $0.50

In studying temperature distribution between two coaxial cylinders in a rarefied gas, thermocouple probe measurements were used in the calculation of radiative heat exchange between the probe and the wall. These measurements were also used to determine the temperature of the gas. Thermoconductivity from the gas to the probe was calculated for a continuous flow. In an intermediate flow, temperature distribution curves varied depending on the degree of motion of the cylinders. Good correlation was shown between theory and experiment. Schematics and diagrams are included, and recommendations are made for extending the technique to a wider range of Knudsen numbers. Transl. by D.T.

**N66-14091#** Centre National de La Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
**SUSCEPTIBILITY OF FROST CRACKING OF SOILS. III: SETTING UP A THERMAL STUDY OF SOILS AND TESTS, WITHOUT FREEZING AND WITH FREEZING, CARRIED OUT ON A WATER-SATURATED SAND MOLD [GELIVITE DES SOLS. III: INSTALLATION D'ETUDE THERMIQUE DES SOLS ET ESSAIS, SANS CONGELATION ET AVEC CONGELATION, EFFECTUES SUR UN ECHANTILLON DE SABLE SATURE D'EAU]**
J. Aguirre-Puente, B. Le Fur, and I. Szanto Jul. 1965 91 p refs In FRENCH
(Rept.-65-5) CFSTI: HC $3.00/MF $0.75

One dimensional heat transfer and mass transfer in soil is investigated to determine its thermal properties, and to verify the theory of congelation of nonconsolidated media and the theory of thermal diffusion. Further, this investigation enables the systematic classification of frost-cracked soils. Tests were conducted on water saturated sand molds, both frozen and unfrozen, and thermal conductivity was determined in each case. Results show that, given the porosity and the thermal properties of unfrozen sand, it is possible to deduce the thermal properties of frozen sand and the rule for the spread of congelation. Appendices are presented on the theories of congelation and thermal diffusion, and a calculation is made for temperature distribution in a mold of finite length. The experimental methods and the various tests are described, and the results are given. Drawings, graphs, schematics, and tables are included. Transl. by D.T

**N66-14115*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**JET EXHAUST MEASUREMENTS**
Barry Yaffe *In its* Goddard Summer Workshop Program [1964] 6 p (See N66-14101 04-14) CFSTI: HC $6.00/MF $1.50

The following techniques were investigated as methods for the measurement of temperature: acoustic pulse thermometer, radiation techniques, magnetohydrodynamic thermometer, resistance thermometer, and thermocouple. The shielded compensated thermocouple is suggested as a method of measuring the stagnation temperature in the gas plume of a low-level thrustor. In arriving at this recommendation, many properties of the plume were implicitly assumed. For example, the use of any convective heat-transfer sensor such as the thermocouple assumes that this mode of heat transfer is both dominant and subject to measurement and analysis. However, a gas of very low density exhibits convective heat transfer to a much smaller degree than does an ordinary gas. The degree and mode of heat transfer in low-density supersonic gas plumes will be met often in problems of this sort. The determination of the shape of the plume and its structure in the presence of obstacles is also given as requiring further investigation. E.E.B.

**N66-14154*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EXPERIMENTAL INVESTIGATION OF NOZZLE CRITICAL FLOW CHARACTERISTICS OF SODIUM VAPOR**
Stanley M. Nosek and Louis J. Goldman Washington, NASA, Jan. 1966 21 p refs
(NASA-TN-D-3183) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Critical flow rates and pressure ratios of sodium vapor through an axisymmetrical convergent–divergent nozzle were measured to determine the characteristics of the flow process. The vapor flows were measured from condensate flows by a volumetric measurement technique whereby the condensate, at steady-state conditions, was allowed to flow into an auxiliary tank and the rise in level between two electrical resistance-type probes was timed. Pressures at the inlet and the throat of the nozzle were measured with an inert-gas injection technique. Flows at nozzle inlet pressures from approximately 5 to 13.5 pounds per square inch absolute at saturation temperatures and with up to 100° of superheat were investigated. The receiving (condenser) pressure was maintained low enough to allow complete expansion through the supersonic nozzle. Comparison of results with theoretical flows for an equilibrium process and a supersaturated-frozen process showed closer agreement with those for an equilibrium process. A calculation for the process wherein the vapor is supersaturated but the molecular species are in equilibrium indicated, however, that a process of this nature may be the best model for representing the flow. Author

**N66-14174#** International Research and Development Co., Ltd., Newcastle (England).
**A FEASIBILITY STUDY ON THE USE OF POWDERS AS HEAT TRANSFER MEDIA IN IRRADIATION CAPSULES**
J. L. Evans 1965 21 p refs
(TRG-920(D/X)) HMSO: 2s 6d

Factors affecting the physical properties of ceramic powders considered at heat transfer media in irradiation capsules are discussed. The required physical properties considered are shearing flexibility, thermal conductivity, and compatibility of the powder with possible cladding materials. Packing density, stress transmission, thermal transmission, and sintering are also discussed. Thermal conductivity curves of magnesia/helium mixtures at 1000, 500, 50 and 15 lb/in.$^2$ abs; of beryllia/helium mixtures at 15 lb/in.$^2$ abs of different sizes and packing densities; of solid beryllia; of magnesia; of aluminum trioxide; of silicon carbide; of graphite; and of helium, calculated from literature data, are given. A high degree of flexibility in the factors considered were found to be incompatible with a high conductivity, and thus it is suggested that the use of powders for high heat rating applications is not feasible. Experiments to determine the physical properties of powders for low heat rating applications are suggested. L.S.

**N66-14210#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**EFFECT OF VIBRATION ON HEAT TRANSFER FROM CYLINDERS VIBRATED SINUSOIDALLY WITHIN A VERTICAL PLANE IN FREE CONVECTION**
William J. Watson (M.S. Thesis) [1964] 58 p refs
(GAW/ME/65-3; AD-623617) CFSTI: HC $3.00/MF $0.75

Methods to increase the heat transfer rate from a body to its surroundings include the effects of vibration. The study is an investigation of the effect of sinusoidal vibration in a vertical plane on the heat transfer rate from a cylinder in free convection in air. Three different cylinders with diameters 0.072 in., 0.120 in., and 0.25 in. were vibrated at amplitudes from 0 to 1.5 in., at frequencies from 16 to 80 cps, and at surface temperatures of 100° F and 200° F above room temperature. The heat transfer rate changes from that obtained in a free convection process to that obtained in a forced convection process at the conventional forced convection curve of McAdams and generally parallels this curve to Reynolds numbers as high as 1100 which was the highest obtained. For a given Reynolds number, the heat transfer rate is independent of the cylinder temperature and test position along the length of the cylinder. The results of this investigation agree closely with results previously presented for cylinders vibrated in free convection in air, regardless of the mode or method of vibration. The scope of the investigation was limited by vibrating characteristics of the

cylinders, failure of the cylinders at higher temperatures, and the limited mass of the mounting assembly for the cylinders. Author (TAB)

**N66-14271#** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**TANK HEATING CODES TIC-TOC AND TOE FOR THE IBM 7090 COMPUTER**
H. C. Woodsum and P. C. Heiser Jan. 1963 59 p ref
(WANL-TNR-083)

Two codes, TIC-TOC and TOE, were formulated for a 32 K IBM-7090 computer in order to calculate integrated heating, heating distributions, and temperature rise in the hydrogen propellant contained in the propellant tank of a NERVA vehicle produced by incident reactor radiation. TIC-TOC calculates the temperature rise vs. operating time for two fluid flow models, the heating distributions, and the integrated heating in the liquid hydrogen propellant for 3 group neutron and gamma reactor equivalent point sources. TOE calculates the heating density in the hydrogen from n, $\gamma$ reactions. The approximate running time for TIC-TOC is 1 minute per case while that of TOE is about 1 minute per receiver point or about 20 minutes for a complete map of the secondary gamma heating distribution. Author

**N66-14295*#** General Electric Co., Philadelphia, Pa.
**LABORATORY SIMULATION OF HYPERVELOCITY HEAT TRANSFER PROBLEM DURING PLANETARY ENTRY**
J. S. Gruszczynski, W. R. Warren, Jr., and N. S. Diaconis [1964] 83 p refs Presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964 Prepared for JPL
(Contracts NAS7-100; JPL-950297)
(NASA-CR-68977) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Laboratory techniques for simulating superorbital velocity planetary atmosphere entry heat transfer environments are outlined, and the results of using these techniques are discussed. It was shown that electric arc driven shock tubes can be used for studying both the equilibrium and nonequilibrium stagnation point convective heat transfer and high temperature gas radiance at conditions corresponding to flight velocities in excess of the earth's parabolic speed. The stagnation point steady state ablation performance of two general ablator types were evaluated in a high purity–high enthalpy free jet arc facility in air, nitrogen, and nitrogen–carbon dioxide gas mixtures. Results indicate that the performance does not differ grossly between air and the simulated planetary atmospheres for the materials and test conditions investigated. A test technique was also described for evaluating material performance in environments with a significant amount of radiation heat transfer. Diagnostic measurements of total enthalpy and heat transfer in established air flows indicated its potential application to materials studies on planetary entry vehicle designs. M.G.J.

**N66-14301#** Aerospace Corp., San Bernardino, Calif. Weapon Systems Div.
**NONEQUILIBRIUM ANOMALIES IN THE DEVELOPMENT OF DIFFUSION FLAMES**
Paul M. Chung, Francis E. Fendell, and James F. Holt Sep. 1965 41 p refs
(Contract AF 04(695)-669)
(TDR-669(S6951-90)-1; BSD-TR-65-448; AD-623331) CFSTI: HC $3.00/MF $0.50

The development of diffusion flame is analyzed for the stagnation mixing layer created by a jet of fuel injected into the oncoming stream of oxidant at the stagnation region of blunt body. From the analysis, the conditions which distinguish the simple and multiple transitions, from each other, between frozen and equilibrium chemical states were clarified. Though the actual numerical results were obtained for the stagnation mixing layer geometry, the basic findings of the analysis should hold for other diffusion flames also. Author (TAB)

**N66-14316#** Naval Ordnance Test Station, China Lake, Calif.
**TRANSPIRATION COOLING WITH LIQUID METALS. PART 2: THEORETICAL DETERMINATION OF OPTIMUM COOLING PARAMETERS NEAR STAGNATION REGIONS**
William H. Thielbahr Aug. 1965 65 p refs
(NOTS-TP-3791; NAVWEPS-8732, Pt. 2; AD-623020) CFSTI: HC $3.00/MF $0.75

Three cooling mechanisms associated with liquid metal transpiration near stagnation regions were investigated theoretically. The cooling mechanisms considered were boundary layer shielding, heat absorption by vaporization, and heat absorption within the matrix as coolant travels under the action of some pressure force to the hot surface. Optimum coolant flow rate necessary for complete vaporization of liquid coolant at the hot wall was derived from knowledge of these mechanisms. Lithium, tin, and copper were the metal coolants investigated, with gaseous helium being included for comparative purposes. Tungsten was the matrix material for all coolants. Results of this analysis demonstrate that each coolant's effectiveness depends on the magnitude of the heat flux. In general, low melting point is the desirable coolant property at low and intermediate heat fluxes, while low molecular weight and high heat of vaporization become the important properties at high heat fluxes. Author (TAB)

# 34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

**N66-13340#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**FOREIGN SCIENCE BULLETIN, VOLUME 1, NO. 10 Monthly Review of Selected Foreign Scientific and Technical Literature**
Oct. 1965 55 p refs

CONTENTS:

1. SOME NEW CONCEPTS OF MINIATURIZATION OF STORAGE ELEMENTS R. R. Zavistovich p 1–5 refs (See N66-13341 04-10)
2. INDIRECT FREE-CARRIER-ASSISTED ABSORPTION AND RECOMBINATION AND THE POSSIBILITY OF NEGATIVE ABSORPTION BY SUCH A MECHANISM C. Shishkevish p 6–13 refs (See N66-13342 04-26)
3. DEVELOPMENTS IN SOVIET TWILIGHT RESEARCH D. W. Michaels p 14–17 refs (See N66-13343 04-13)
4. THE SEARCH FOR HEAT-RESISTANT POLYMERS B. Nartsissov p 18–29 refs (See N66-13344 04-18)
5. STATUS OF THE AIRSHIP IN THE USSR V. Mutschall p 30–36 refs (See N66-13345 04-02)

SCIENCE & TECHNOLOGY NOTES

6. NEW COMPACT ANTENNA (USSR) p 37–39 (See N66-13346 04-07)

7. CRYSTAL STRUCTURE OF LANTANUM DITELLURIDE (USSR) p 39–40 refs (See N66-13347 04-26)

CONFERENCE

8. RESEARCH IN THE FIELD OF ORIENTED GLASS-REINFORCED PLASTICS (USSR) p 41–44 (See N66-13348 04-18)

**N66-13375*#** American Machine and Foundry Co., Santa Barbara, Calif. Advanced Products Group.

**SPACE TECHNOLOGY APPLIED TO MAN'S EARTHLY NEEDS: FEASIBILITY STUDY ON THE TRANSFER OF AEROSPACE TECHNOLOGY TO INDUSTRY USE**

Albert Nagy, Walter J. Dembiczak, and A. Wade Brock Apr. 1965 81 p refs

(Contract NASw-1139)

(NASA-CR-68620; ER-SB-1844) CFSTI: HC $3.00/MF $0.75 CSCL 05A

This report on space technology as it applies to man's earthly needs covers Phase I of a feasibility study on the acceleration of transfer of aerospace technology to commercial industry. During the four-month period of the experiment, a determination was made of the extent of the present use of NASA technology within an industrial family—AMF. Typical needs were determined. A survey of aerospace literature, its quality, quantity and availability from the aspect of the non-aerospace user was accomplished. Forty-seven specific candidates for transfer of knowledge to satisfy needs were formulated. Aerospace literature was reviewed from the aspect of applicability. Six good candidates for transfer were established. Recommendations were made for the continuance of Phase II of the study. Author

**N66-13383#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**REPORTS OF THE ACADEMY OF SCIENCES OF THE USSR Selected Articles**

3 Aug. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 159, no. 1, 1964 p 39–42; 196–197 (FTD-TT-65-540/1+2+4; AD-619484) CFSTI: HC $1.00/MF $0.50

CONTENTS:

1. STUDYING A SUPERSONIC AIR AND CARBON DIOXIDE FLOW AROUND A SPHERE AT THERMOCHEMICAL EQUILIBRIUM G. F. Telenin and G. P. Tinyakov p 1–6 refs (See N66-13384 04-12)

2. OBSERVATION OF ELECTRON PARAMAGNETIC RESONANCE OF THE TRIPLET STATE OF CHLOROPHYLL G. T. Rikhireva, Z. P. Gribova et al p 7–9 refs (See N66-13385 04-06)

**N66-13388#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 247**

26 Nov. 1965 77 p refs Transl. into ENGLISH from Chinese periodicals

(JPRS-33046; TT-65-33623) CFSTI: $3.00

CONTENTS:

1. EXPERIMENTAL DETERMINATION OF INERTIA PARAMETERS OF MOVING BODY UNDER WATER K.-h. Chao and Y. Chiang p 1–47 refs (See N66-13389 04-12)

2. STUDIES ON ATMOSPHERIC CIRCULATION IN THE STRATOSPHERE AND THE EFFECT OF SOLAR ACTIVITY ON ATMOSPHERIC CIRCULATION p 48–53 (See N66-13390 04-13)

3. MEANS OF IMPROVING CORROSIVE RESISTANCE OF ALLOYS C.-m. Ch'en p 54–75 refs (See N66-13391 04-17)

**N66-13405#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, No. 232**

3 Nov. 1965 38 p refs Transl. into ENGLISH from Chinese publications

(JPRS-32683; TT-65-33162) CFSTI: $2.00

CONTENTS:

1. AREANE COMPLEXES OF TRANSITION METALS K.-y. Hou p 1–28 refs (See N66-13406 04-06)

2. BRIEF REPORTS ON SCIENTIFIC ACTIVITIES p 29–31

**N66-13413#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 235**

9 Nov. 1965 62 p refs Transl. into ENGLISH from selected Chinese articles

(JPRS-32770; TT-65-33348) CFSTI: $3.00

CONTENTS:

1. HEAT STABLE HETEROCYCLIC POLYMERS M.-h. Ting p 1–28 refs (See N66-13414 04-06)

2. TRANSISTOR D. C. SOURCE CONVERTER Chun-ang Liu p 29–39 refs

3. ANTENNA AND INPUT CIRCUIT DESIGN FOR SUPERHETERODYNE TRANSISTOR RECEIVERS Tso Yen p 40–51

4. CCH-J-1 SUPERSONIC THICKNESS MEASUREMENT INSTRUMENT I-shih Wu p 52–60

**N66-13416#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NUMBER 237**

10 Nov. 1965 34 p refs Transl. into ENGLISH from selected Chinese articles

(JPRS-32819; TT-65-33397) CFSTI: $2.00

CONTENTS:

1. ADHESIVES FROM PHENOL-FORMALDEHYDE-RUBBER Y.-c. Huang p 1–30 refs (See N66-13417 04-06)

2. SPUR DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN SOLVING PRODUCTION PROBLEMS p 31–32

**N66-13419#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 233**

5 Nov. 1965 76 p refs Transl. into ENGLISH from Chinese periodicals

(JPRS-32737; TT-65-33215) CFSTI: $3.00

CONTENTS:

1. A NUMERICAL EXPERIMENT OF THE GENERAL CIRCULATION OF THE ATMOSPHERE H.-s. Ch'en p 1–32 refs (See N66-13420 04-13)

2. A NUMERICAL EXPERIMENT OF CUMULUS DEVELOPMENT H.-p. Chou, H.-s. Li, Y.-k. Chang, and T.-c. Kung p 33–51 refs (See N66-13421 04-20)

3. ON-TH-SHOP RESEARCH WORK ON PREVENTING RINGWORM p 52–53

4. RESEARCH WORK TO SERVE SOCIALIST CONSTRUCTION p 54–56

5. MEDICAL RESEARCH AND PRACTICE IN THE CPR I.-c. Aderca p 57–60

6. ELECTRONICS IN AERIAL SURVEYING W.-h. Kuo p 61–66 (See N66-13422 04-20)

7. CHINA'S ACHIEVEMENTS IN NEUROSURGERY Yu-ch'uan Shih p 67–74

**N66-13617#** Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

**RESEARCH PROGRAM ON THE MANAGEMENT OF SCIENCE AND TECHNOLOGY. TIME ALLOCATION AMONG THREE TECHNICAL INFORMATION CHANNELS BY R & D ENGINEERS**

Thomas J. Allen and Maurice P. Andrien, Jr. Aug. 1965 25 p refs

(Grants NSF GN-233; NSF GN-353)

(Rept.-131-65)

Four parallel research and development projects are examined to determine the manner in which engineers and scientists allocate their time, and the effect of this allocation on the outcome of the projects. The use of matched pairs of projects allows the relative evaluation of outcomes by technical monitors in the customer agencies. It is seen that the percent of total time spent in three categories of information gathering (outside consultation, staff consultation, literature search) varies significantly over the life of a project. Higher rated teams are relatively stable in all phases of information gathering while lower rated teams initially spend far more time gathering information than they do in the later stages, and fluctuate more throughout the project. It is also seen that subsystems characterized by greater uncertainty receive a higher percent of information gathering time than subsystems where uncertainty is lower. C.T.C.

**N66-13622*#** National Aeronautics and Space Administration, Washington, D. C.

**SPACE AND THE INTERNATIONAL COOPERATION YEAR, A NATIONAL CHALLENGE**

Arnold W. Frutkin [1964] 20 p

(NASA-EP-30) GPO: HC $0.20; CFSTI: MF $0.50 CSCL 22B

Attention is directed towards the ever increasing need for international communication and cooperation in the area of space sciences. It was pointed out that international cooperation could prosper much more under the auspices of organized committees and programs. A brief discussion is given which covers international research based on the program of the U.S. National Aeronautics and Space Administration, touching on NASA's joint operations with Canada, the USSR, and European regional organizations. C.L.W.

**N66-13644#** Congress. Senate. Committee on Aeronautical and Space Sciences.

**NATIONAL SPACE GOALS FOR THE POST-APOLLO PERIOD**

Washington, GPO, 1965 388 p Hearings before Comm. on Aeron. and Space Sci., 89th Congr., 1st Sess., 23–25 Aug. 1965 GPO: $1.00

Alternative goals for the national space program following the manned lunar landing are the subject of hearings held before the Senate Committee on Aeronautical and Space Sciences on August 23, 24, and 25, 1965. Speakers included Dr. James E. Webb, Dr. Robert C. Seamans, Jr., and Dr. George E. Mueller. Payloads and exploration capabilities are considered along with planetary missions and solar, chemical, and nuclear power systems. Bioscience laboratories and life support systems technology are discussed. A description of NASA support for research at universities is included. M.W.R.

**N66-13973#** Rome Air Development Center, Griffiss AFB, N. Y. QRC Branch.

**DOCUMENT DESTRUCTION Final Report, Jan. 1963–Feb. 1965**

Vincent N. Rice and Lewis C. Miller Oct. 1965 26 p

(RADC-TR-65-362; AD-623506)

The results of tests that were conducted with various types of paper and substitute materials are as follows. Destruction by burning and shredding has a drawback in that the weight of equipment that would be required for destruction for RADC applications would be too much. Other problems encountered were the production of a large amount of smoke with burning of large amounts of paper and clogging of the shredder. Too long a period of time would also be required for complete destruction in application of both techniques. Of the synthetic materials, polystyrene is the best material encountered for RADC intended use. The principal advantage is that polystyrene can be destroyed rapidly in a wide range of organic liquids. The problems involving bending and tearing can be solved with sufficient development. Special grades of 59AF, 58A, and 59F (with viscose stable fibers) meet the specifications as a replacement for bond paper. They can be destroyed very rapidly in both water and by burning. The burning of 59AF, however, produces a lot of smoke which in some instances might be very undesirable. In comparing 59AF with polystyrene the main advantage lies in the fact that 59AF has a more paperlike characteristic than polystyrene and could probably take printing from type with more ease. TAB

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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